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The wrong tyres

Why today's young racing drivers would do well to learn the noble art of sliding

When Pablo Picasso said it took him 10 years to understand how kids paint, and then an additional 10 years to learn how to paint as kids do, he operated with a few basic colours instead of fiddling around for days on end with 27 shades of turquoise and magenta. Children paint with green, blue, yellow and red. There isn't yet any finesse, they don't bother with nuances, they do the macro. And they just get on with it.

Slip and slide

In *Automobile Year* number two (1955), Richard von Frankenberg published an article titled '15 percent slip'. It features a graph showing the highest μ of 0.85 at 15 per cent slip. Von Frankenberg was talking about Formula 1 cars, the Sunday afternoon vehicles of the likes of Ascari, Moss and Fangio.

Those 15 per cent correspond to 13.5 degrees of lateral slip. The 0.85 friction coefficient would nowadays be closer to that of a decent rain tyre, rather than that of the worst worn out slick, but back then going fast simply meant sliding a lot, visibly, to the joy of the watching audience.

Over time, the size of the tyre's contact patch has tripled, or more. Since von Frankenberg's 13.5 degrees, the 'peak of grip' slip angle has slowly decreased, while the drop off after that peak has moved closer and closer to that angle. In other words, the grip level has increased massively, but the operating window has become narrow and ever more difficult to stay inside.

Forced finesse

Junior racers in Formula 4 cars are taught, pushed and forced to drive with a maximum of finesse and precision, skipping completely the 'macro' of driving a four-wheel vehicle.

In my use of the word macro here, I mean the roughness of over-the-limit attack, the exaggeration, the obvious mistake, the spectacular slide.

Most F4 cars in the world now are shod with excellent, wide and very sticky slicks. Add some downforce to that and there is only one way to drive them efficiently. It is called 'at approximately three, and between two and four degrees of slip angle.'

Car control

How poor is that compared to Fangio, Ascari and Moss' art of car control? Okay, that is going too far back. However, it still sounds very poor when compared to Ayrton Senna sliding the complete car at eight to 10 degrees or, with a great amount of oversteer, nothing less. It is no surprise that he felt perfectly at ease with a decent amount of oversteer on a qualifying lap, with 700bhp, at 250km/h through Maggotts and Becketts. No surprise either that he had an adequate solution for adjusting his driving style and correcting the lines in the rain.

Today, when a junior driver gets a touch too much oversteer in any one of the 20 corners on a lap, we call it 'the mistake that ruined their lap.'

XPB

Old racing drivers were applauded for driving on, or outside, the limit. Current ones are told off for doing so

Those excellent tyres are to blame. Not the company producing them, but rather the organiser or promoter choosing them. However, it isn't that simple either. The modern racecar is designed to use them, and the regulations written for them. Plus, people like the look of the fat tyres.

The same can be said for the completely useless wings fitted during a junior driver's first year schooling in cars. It doesn't teach the full story and is very expensive for no good reason.

The driver that learns to slide properly, the one who dares to run wide here and there to see what happens, will be best prepared for the odd situation when they are *forced* to go wide, and then have to adapt to dirty tyres for the next seven corners.

They may then see the opportunity to go off line that little bit on corner turn in to better prepare themselves for an overtake on the next straight. They may also have better judgement when experiencing a sudden, rain-induced variation in grip.

Drawing board

Unfortunately, the clinical approach of today's engineers and all the data assists aren't teaching drivers the full story.

Going back to the painting analogy, primary school teachers don't punish children for painting outside the lines, yet we do exactly that with racing drivers. Sometimes matters evolve in the wrong direction.

People are no longer used to seeing wingless cars on skinny tyres in racing paddocks. And we won't again until someone shows the guts to create the perfect category for that kind of racecar again, with a safe, innovative, good-looking concept that, at the same time, reduces the ridiculous costs for entry-level, single-seater racing. If and when that does happen, Fangio, von Frankenberg and Picasso will love it.

Grip level has increased massively, but the operating window has become narrow and ever more difficult to stay inside

Eyes on the Bull

In an attempt to catch Red Bull, several teams moved towards a similar design for the new season, only to be met by a radical response from the reigning champion

By DANIEL LLOYD

Formula 1 has just passed the midpoint of the current technical regulations cycle. Ground effect cars returned in 2022 and now have two seasons under their belt, but they still have two more to run before the hotly anticipated power unit overhaul arrives in 2026.

In planetary terms, F1 recently reached the furthest point of its current technological orbit. However, as more time passes and the 2024 season runs its course, so the perihelion and the start of a new cycle will draw closer. The sense of distance was expressed in a lack of changes to the technical regulations for the new season.

The porpoising problems of 2022 were largely alleviated with sweeping changes, including increases in the floor and diffuser throat heights. No such wholesale issue manifested last year. Any performance shortcomings came down to individual cases at the teams that could be addressed through upgrades.

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By comparison, the regulatory adjustments made for 2024 were relatively minor. Cars may now run with an optional cooling scoop on the upper surface of the forward chassis, in response to several drivers struggling through a brutally hot Qatar Grand Prix. The drag reduction system (DRS) can now be activated one lap after a race start or re-start. And a decision to reduce the number of power unit components per car per season from four to three was repealed for this year and next.

Consequently, the focus at the start of this season was on performance gains, specifically whether any team could stem Red Bull Racing's dominance.

Red Bull blitzed the first two seasons of the ground effect rule set, winning 86 per cent of the grands prix held during that time. The Milton Keynes-based team had the best grasp of what was required from the outset, while others needed time to grapple with concepts that weren't as effective.

Parity gap

Heading into year three of the current rules, the teams playing catch up have made further changes to their designs, some of them significant and some of them complying with the word of the moment – convergence – by parroting the direction of the downwash aero concept that Red Bull mastered.

F1's parity measures (the cost cap and scaled wind tunnel and CFD testing in favour of lower-ranked teams) continue to simmer in the background, and now is the time those gradual measures would reasonably be expected to start bearing fruit.

'This is the first year of the new regs where microscopic shapes are starting to converge,' said McLaren team principal, Andrea Stella.

'At the same time, a lot of the potential for performance is in the details.

'Over time, hopefully we see the budget cap and aero restrictions starting to have an effect. Then, these regulations will allow a level playing field to be generated.'

In late January, Red Bull team principal, Christian Horner, admitted he expected to see 'diminishing returns' this year. However, his technical team has done all within its powers to mitigate that effect with a radical design sidestep that few teams saw coming.

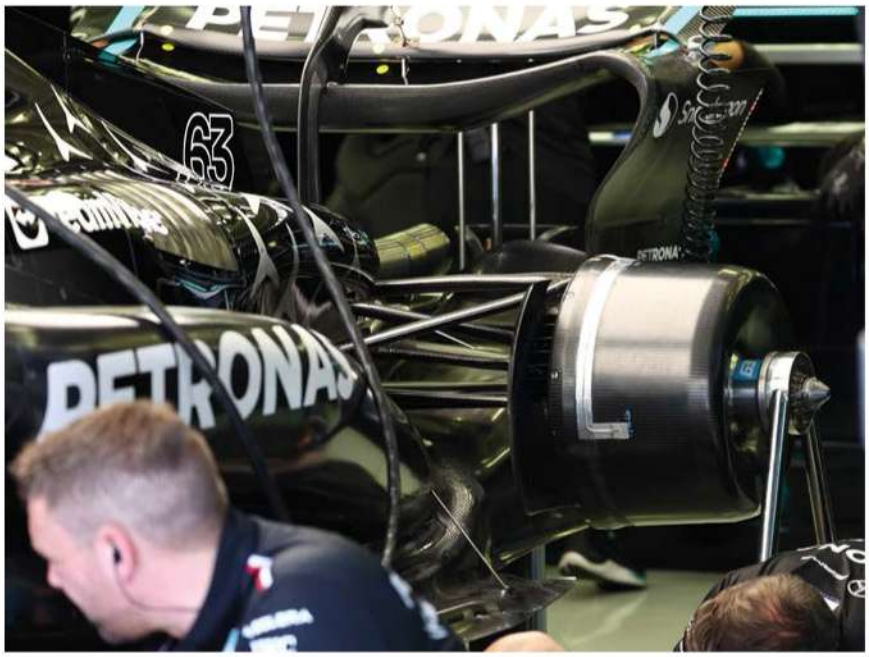
The sidepod inlets of the RB20 were craftily hidden during the car's launch event, but it was clear something different had been done. Ideas about the reasons for this only emerged one week before the season start, during F1's test in Bahrain.

Shapes of things

The RB20 arrived with tiny horizontal sidepod inlets compared to the rest of the field, taking last year's letterbox-style design to the extreme. Really, it had gone beyond a letterbox, as you could scarcely fit a Sunday paper through the minute gap tucked under an upper lip of bodywork. It hinted at clever packaging as the radiators have been squeezed into an even smaller space alongside the chassis.

Red Bull's engineering brains trust, led by its chief technical officer, Adrian Newey,

The focus at the start of this season was on performance gains, specifically whether any team could stem Red Bull Racing's dominance



Mercedes caught the attention of other teams with the evolutions introduced on the W15, including a switch to pushrod rear suspension, an adjustable rear wishbone upper leg on the front, and a novel strip on the front wing

Not wanting to get caught by rivals that were inspired by its successful downwash aero design, Red Bull went for something completely different on the RB20. The two sidepod intakes, one horizontal and one vertical, are seen here

Other teams' engineers were impressed by what they saw, feeling Red Bull has not sat back on its laurels, but continues to push its design concepts and come up with new ways to keep its car ahead. More importantly, the team does not appear to have been hampered by having the least off-track testing available due to its dominant position

McLaren's pre-season testing was impacted by a fuel system issue that interrupted one of its race simulation runs

chief engineer, Paul Monaghan, and technical director, Pierre Waché, also fitted a narrow vertical inlet tucked in close to the car body and inlets on either side of the cockpit.

Senior personnel at other teams were surprised and impressed in equal measures at Red Bull's design twist, which came despite the team being restricted to the smallest off-track testing allowance.

'I have to say when I saw the car, I was like, wow,' reacted Stella. 'They certainly were brave in changing some of the shapes that made that car so successful last year.

'I think they could enjoy such an advantage last year that it gave them the confidence, from a timeline point of view, to take some risks.'

Jody Egginton, technical director of the RB team that was called AlphaTauri last year, agreed that the RB20 was one of the eye-catching designs.

'The packaging of the Mercedes and Red Bull are very interesting, and very nice,' he said. 'It's an eye opener… both of those teams have done a couple of things that are slightly different to what's gone on in previous years. Credit to them, that's caught our attention.'

Trend spotting

'Generally, everyone is looking at what everyone else is doing, trying to piece together what might have led them in that direction,' Egginton added. 'We're spotting things on other cars that we have run through CFD and the wind tunnel. Maybe at the time [it] didn't appear to be something we're going to take forward, so it's always interesting looking and going, let's have a go again.'

Mercedes entered pre-season testing with some interesting developments not seen anywhere else on the grid. The first was a strip of carbon fibre on the upper flap of the front wing. The strip helps to create a vortex that produces outwash, guiding air around the car and reducing drag.

This immediately raised eyebrows, with F1 chief technology officer, Pat Symonds, questioning whether it could be interpreted as pushing the spirit of the rules, which were designed to minimise outwash and facilitate cars following each other closely.

Mercedes was adamant the part was applied following dialogue with the FIA, dismissing concerns over its legality.

Another feature of the W15, albeit a less contentious one, was Mercedes' movement of the front suspension rear wishbone upper leg. On day three of testing, the inboard mounting point was pushed a few centimetres down. It is unclear what level of adjustability the team has between those points, but it served to indicate that Mercedes has different options to manage its platform control depending on the circuit.

Push and pull

Even if the current regulations are well established, teams have been chopping and changing their suspension layouts. Four of the 10 teams have made significant alterations in that department this year. Mercedes and Aston Martin have opted for a pushrod configuration at the rear, while RB and Sauber have adopted pull rod on the front.

Perhaps the more interesting story, though, is what Mercedes power unit customer, Williams, has done (or, more accurately, what it hasn't done). Unlike Mercedes and Aston, the Grove-based team did not adopt pushrods on the rear, as confirmed during the FW46's maiden roll out on the eve of pre-season testing.

'Mercedes is already committed to providing suspension, and could only physically make two sets of this year's stuff,' said Williams chief technical officer, Pat Fry. 'Therefore, we picked up last year's. It's more a case of logistics than a choice, as such.'

Fry, who joined Williams last summer, went on to explain that the team did not have a contract with Mercedes to receive its latest gearbox, which precluded it from switching to the pushrod rear suspension layout as the two are linked.

'We have designed our own suspension within the '23 box,' he confirmed. 'It's got a set of different suspension tuning options to what we had before. We've lost some things and gained some things. We've got a new set of tools in the toolbox, and we need to know how to use them.'

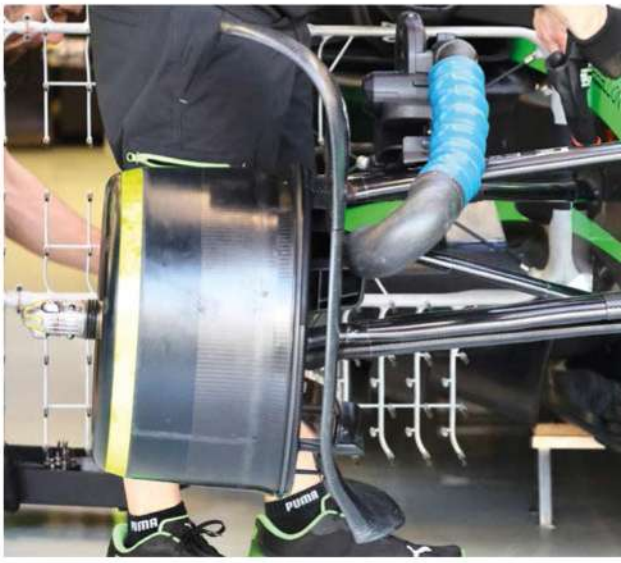
RB and Sauber both went to pull rods on the front and pushrods on the rear, having fielded cars with pushrods at both ends in 2023. This brings the two midfield hopefuls in line with Red Bull's approach and leaves Alpine as the only competitor running with an all-pushrod philosophy.

Sauber's CFD modelling in late spring and early summer of last year led to it deciding to make a first attempt at the front pull rod.

'A pull rod is better aerodynamically, but worse in every other sense,' explained Sauber technical director, James Key. 'What makes it difficult is that, in every mechanical respect, it's a compromise.

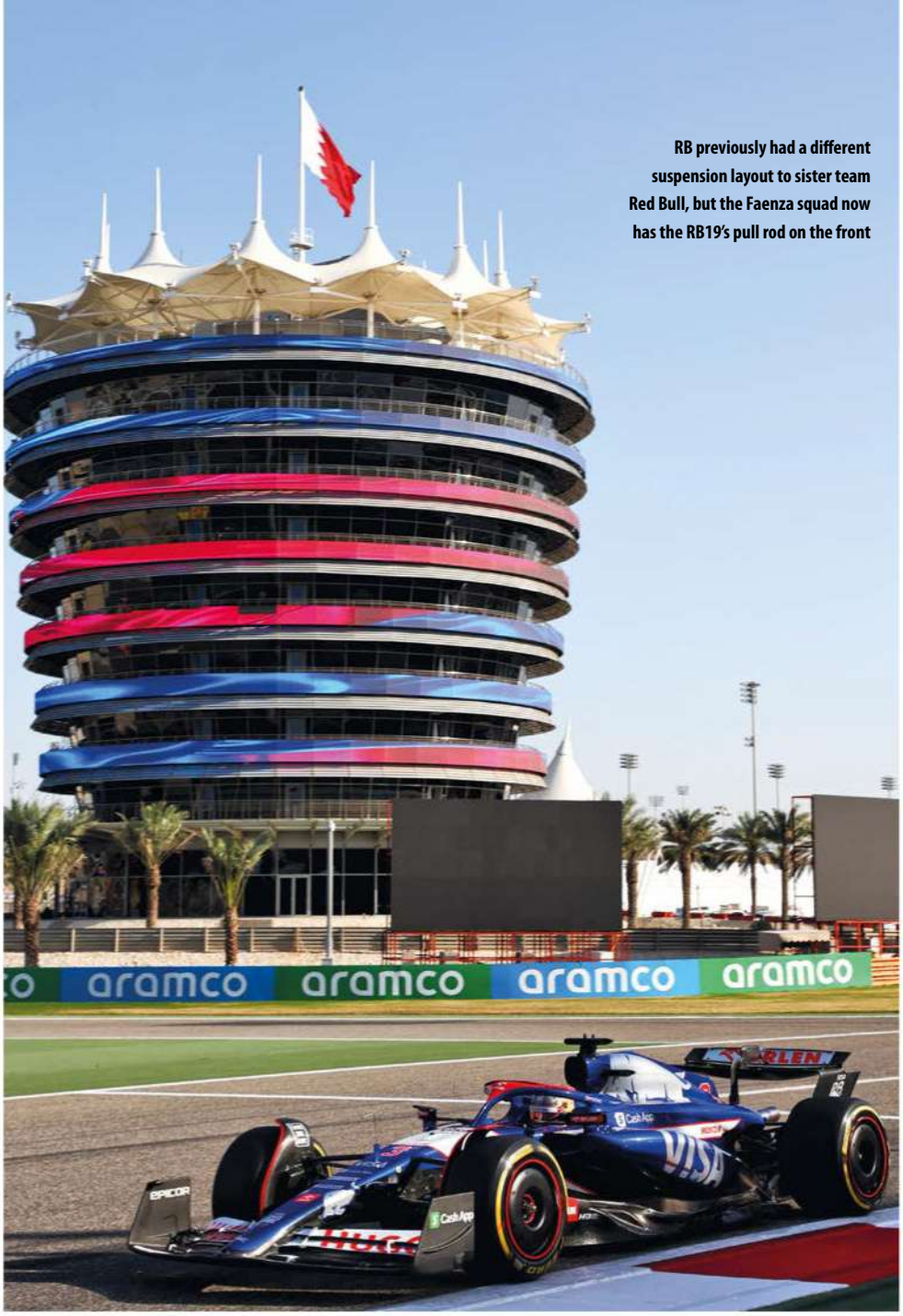
'Generally, everyone is looking at what everyone else is doing, trying to piece together what might have led them in that direction'

Jody Egginton, technical director at RB



Williams stuck with pull-rod rear suspension because of limitations in what Mercedes could produce for 2024, but the British team's chief technology offier Pat Fry said this didn't force it to change other elements of the FW46 design

Sauber claimed to have left some pace on the table after pre-season testing. The Swiss team's technical director James Key said the C44 offers an improvement in through-corner balance, partly due to suspension internal developments



RB previously had a different suspension layout to sister team Red Bull, but the Faenza squad now has the RB19's pull rod on the front

'All of the springs and dampers are effectively working the wrong way round. It's all upside down, so it's not a nice layout to have to deal with [and] it adds weight to the car.

'Trying to maintain the compliance values you get from a pushrod, which is a very efficient way of transferring load, is a lot more difficult with a pull rod. So, you'd never voluntarily do a pull rod unless it was on balance better for performance.

'For a relatively small team, everyone has done a great job of finding a very tidy solution that does exactly as it should on the track. But it is a big job. It's really not an easy thing to do without dropping into the trap of big compromises.'

RB has adopted the same pull-rod suspension system used on last year's title-winning RB19. That layout provided exceptional anti-dive under braking and was a continuation of the superior platform control Red Bull enjoyed on the RB18, which could run close to the floor, maximising downforce, while shunning the porpoising effect.

'Yes, we have Red Bull RB19 suspension on the car, but the wetted surfaces that have the most influence are our own,' said Egginton. 'The shrouding is our own. We're still in control of that [and] it's not a guarantee that we get the thing to work exactly as we want, immediately. I'm quite happy with what we've done. Structurally, it's Red Bull parts, and aerodynamically, we still have the authority on what we do to cover those structures.'

Podium hunters

McLaren and Aston Martin both had encouraging seasons in 2023, finishing fourth and fifth respectively. Both teams had purple patches in which they were second best to Red Bull, but at different points.

McLaren came on strong in the second half of the season, while Aston peaked early on. Both teams have since made evolutions, with a view to continuing their push to become season-long podium contenders.

McLaren obscured some technical details when it launched the MCL38, but those soon came to light at testing. For example, the floor edge was more intricate than last year, indicating the team has made further developments to the channelled floor itself.

'I think some of the weaknesses have been improved [on],' said Stella. 'For instance, I would say we are happier with the grip at the rear axle, which was one of the aspects we wanted to work on.

'Overall, there is more grip in the car, though there are some aspects we still have some work to improve. It's not like you have to correct features, you just have to put more grip on the car. [This] mainly comes from aerodynamic performance.

'We have some more margin to improve from a mechanical point of view, and also in terms of interaction with the tyres. In all these three aspects, we plan to bring developments over the course of the season.'

McLaren's late-season improvement was arguably better timed than Aston Martin's quick jump out of the blocks, as the latter struggled to maintain its early form when it applied upgrades during the season.

'The main target we gave to our developing the SF-24 has been to enhance the driveability of our car, to allow our drivers to exploit all the potential'

Enrico Cardile, technical director of chassis and aerodynamics at Ferrari

'We weren't 100 per cent pleased with where we went in our in-season development last year, and we want to make sure we can compete at the top level by mid-season,' confirmed Aston Martin technical director, Dan Fallows.

'We've got a new rear suspension from Mercedes, so we've had to incorporate that. A lot of the things that does is things we would have liked to see anyway, so we've been able to base a lot of our development around that.'

Improved driveability

Ferrari had the distinction of being the only team to beat Red Bull last year, as it capitalised on an abnormal off weekend for the RB19 in Singapore. The Italian constructor's latest car, the SF-24, is visually akin to its SF-23 predecessor, but with a few subtle changes. The team have smoothed the lower surface of the sidepods, which carried a noticeable bulge towards the end of last year.

A focus on generating downwash is evidenced by the sidepod ramping down at a steeper angle, maximising the gap between the rear wheels and the diffuser.

The pull-rod on the rear suspension has been moved forward as Ferrari continues to develop that less popular configuration.

'The main target we gave to our developing the SF-24 has been to enhance the driveability of our car, to allow our drivers to exploit all the potential,' said Ferrari's technical director of chassis and aerodynamics, Enrico Cardile.

'The other target has been to have a robust platform in terms of delivery on track, to make sure all the performance developed in the wind tunnel will be present on track.

'In terms of general targets, the SF-24 is in continuity with what we tried to achieve with the SF-23 during the season, but a big departure from what we did in '22 and '23.'

Aston Martin is one of two teams to have changed to pushrod rear suspension on its new car, the AMR24, and the team hopes to be competing for podium positions by mid-season

Ferrari's SF-24 set the pace in pre-season testing. The Italian squad has completed a shift to the downwash sidepod style, having previously utilised a 'bathtub' design that had a higher edge and a wider channel for air to pass through

Alpine dropped behind McLaren and Aston Martin in last year's standings and is aiming to bounce back with the A524. It has a new chassis, wider nose, narrower sidepod inlets and reworked pushrod suspension on both ends

The off-season developments at Haas are explored elsewhere in this issue, but it's worth touching on the American team here. Reducing the tyre degradation that beleaguered last year's car has been at the heart of the engineering focus for the VF-24.

Haas chalked up the most laps in pre-season testing, with its power unit supplier, Ferrari, completing the second highest number of laps. Although temperatures weren't scorching hot for the Bahrain test, those statistics still implied decent mechanical reliability from the 066/12 power unit.

Engine reliability updates are permitted under the current rules, although teams were also preparing for a reduced allocation that has since been repealed, meaning that all power units should be more reliable.

The consensus among teams at the top of the 2024 season was that Red Bull would remain the firm favourite, based on it appearing to have taken a further step forward in aerodynamic design. But there was also a feeling that the rest of the pecking order was much closer than before, as could be expected from two-year-old technical regulations.

As Red Bull mastered the use of downwashing aero, the likes of Mercedes and Ferrari converged towards that sidepod design. The field therefore looks more similar than it did in the first two years of ground effect's return, with the notable exception being Red Bull. It remains to be seen if any teams choose to follow Red Bull's latest curveball design, if it proves to be as successful as the ones that preceded it.

Haas hoping for more

The American F1 team's technical director and team principal divulge the areas in which the VF-24 could right the wrongs of last season

By DANIEL LLOYD

After finishing last in the 2021 constructors' standings with zero points, Haas at least managed to get off the mark in the first season of the current Formula 1 rules cycle in 2022.

However, after taking one step forward, its results under the ground effect era went a further two steps back last year as it returned to the foot of the table, the team only scoring 12 points, less than half its 2022 total.

The American-owned squad's lack of momentum was followed by team boss, Gene Haas, enacting a major staffing overhaul, removing Guenther Steiner from his long-held post as team principal and promoting technical director, Ayao Komatsu, in his place.

Komatsu came out surprisingly pessimistic about the Haas VF-24's potential in the early part of the new 2024 season, stating that he expected the car to start 'towards the back of the grid, if not last.'

The bar could not have been set lower, but clearly the team wants to raise it as the season progresses, not least Komatsu who has a chance to prove himself as team leader.

The organisational shuffle included the promotion of former chief designer, Andrea De Zordo, to technical director, and the creation of a new performance director role for ex-head of vehicle performance, Damien Brayshaw. Tom Coupland, formerly Haas' head of composite design, stepped up to De Zordo's previous position of chief designer.

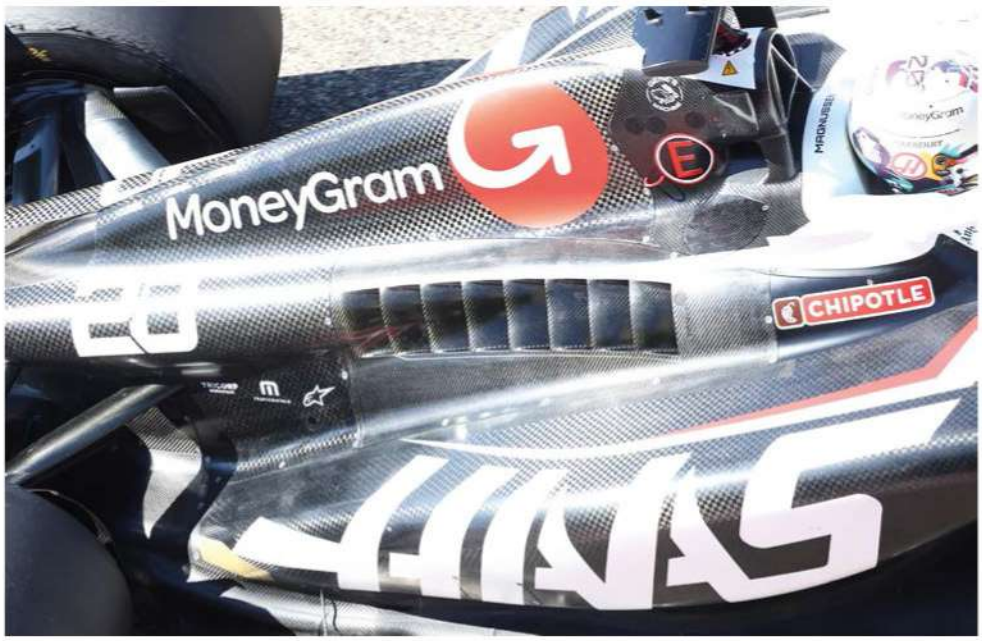
Texan try out

The design of the Haas VF-24, and Komatsu's initially portentous outlook for the start of the season, can trace its roots back to the 18th round of the previous campaign at Circuit of The Americas (COTA), where Haas unveiled its only major upgrade for the unsuccessful VF-23.

Having previously utilised a similar sidepod architecture to its power unit supplier, Ferrari, Haas switched to the downwash variant that worked so well for Red Bull and has become the style of choice. The downwash profile encourages airflow to drop down a ramped section of bodywork towards the gap between the diffuser and the rear wheel, aiding rear-end stability.

Other changes brought to COTA included tweaks to the floor, the front brake duct and the cooling system, with large gill-like openings fitted onto a new engine cover.

Work on the updates for the 2024 car started behind schedule, and consequently wiped out two months of development time on the VF-24. That perhaps prompted Komatsu's frank assessment of the team's chances shortly after he took the reins. However, it wasn't a total loss. De Zordo later indicated that the package tried at COTA did at least have some value in confirming the design direction of the 2024 car.



In a disastrous '23 season, Haas brought some upgrades to COTA, including these gills in the engine cover, which remain on the VF-24

At the Bahrain test, the VF-24's floor appeared to be a work in progress. Sidepod development was a major focus since COTA last year

There were major changes at Haas in preparation for the 2024 season. Andrea De Zordo has moved from chief designer to technical director

The [upgrade] package tried at Circuit Of The Americas [in 2023] did at least have some value in confirming the design direction of the 2024 car

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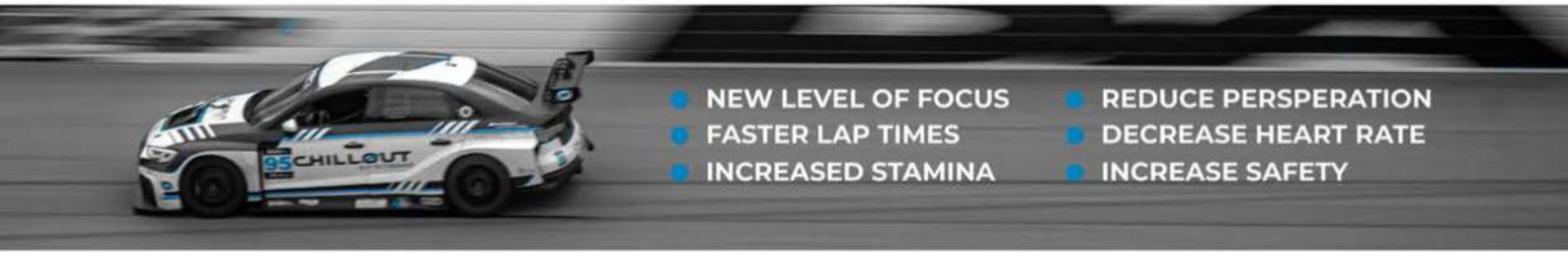

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It's not a straight carry over though. The sidepod inlets on the VF-24 are narrower than those seen at COTA, complementing the deeper undercut. Haas has also made changes to the front wing, adding a third exposed flap end to the rear outer corner of each end plate, and re-working the dive plane on the outside of the end plates to become some of the most detailed in the field.

'This car is just the development of that [update],' says De Zordo. '[It is] the same direction, just before [at COTA] it was just at the beginning. Now it's a lot more developed. Even if it didn't perform as you would hope from a big upgrade package, it was in line with what the numbers said it should have been. So it was positive.'

Cooling systems

Haas has rearranged its cooling system for the VF-24, with the overhead air intake becoming wider as the sidepod inlets shrink. This creates a minor reduction in the efficiency of airflow to the rear wing, but those losses can be worth it for the gains elsewhere.

'You try to minimise the lateral entry,' says De Zordo. 'To do that, you try to trade a little bit in this area, and you have to recover it somewhere. The size of the aero loop is not a big loss, and finally we decided to go for that.'

The VF-24's downwash-generating sidepod design has enabled Haas to re-position the side impact structure and radiators.

'When we designed it initially, we could even do something more extreme, probably as a development of the car,' adds De Zordo. 'We have been ready to take all the geometry advantages that are allowed. We tried to package everything underneath the bodywork in the tightest possible way, in a way that we can have space to develop more. It is something that goes step by step.'

On the driver cooling side, Haas elected not to install the optional ducts that were written into the technical rulebook after last year's heat-related issues in Qatar. With more fundamental engineering matters at stake, it was deemed an unnecessary distraction.

'In the end, it was an extra resource [with] extra weight in the car, for something that there is no requirement for,' De Zordo explains. 'We discussed with the drivers and said, okay, for the moment it will be a hypothesis, just to be sure that if we need at a certain stage to put it in the car. At the moment, though, there is no intention.'

Overheating issue

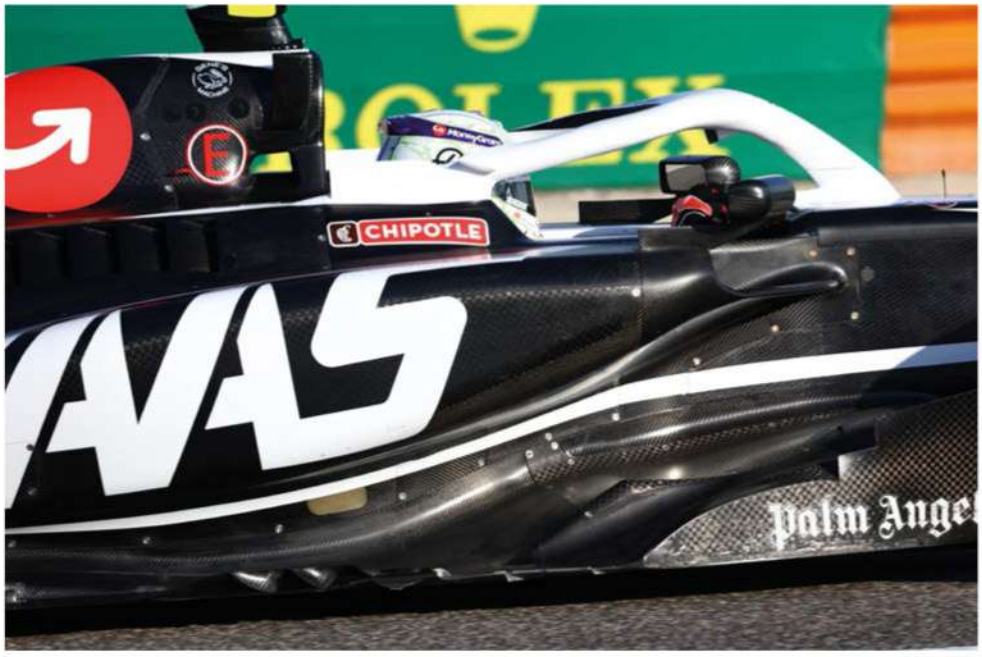
While the drivers didn't overheat last year, the VF-23's rear tyres certainly did. This problem plagued Haas during the 2023 season and overshadowed its outright pace potential.

There were 11 instances of a VF-23 reaching the third and final stage of qualifying, but points were only scored on four occasions.

Haas has also made changes to the front wing, adding a third exposed flap end to the rear outer corner of each end plate, and re-working the dive plane on the outside of the end plates to become one of the most detailed in the field

TECH SPEC: Haas VF-24

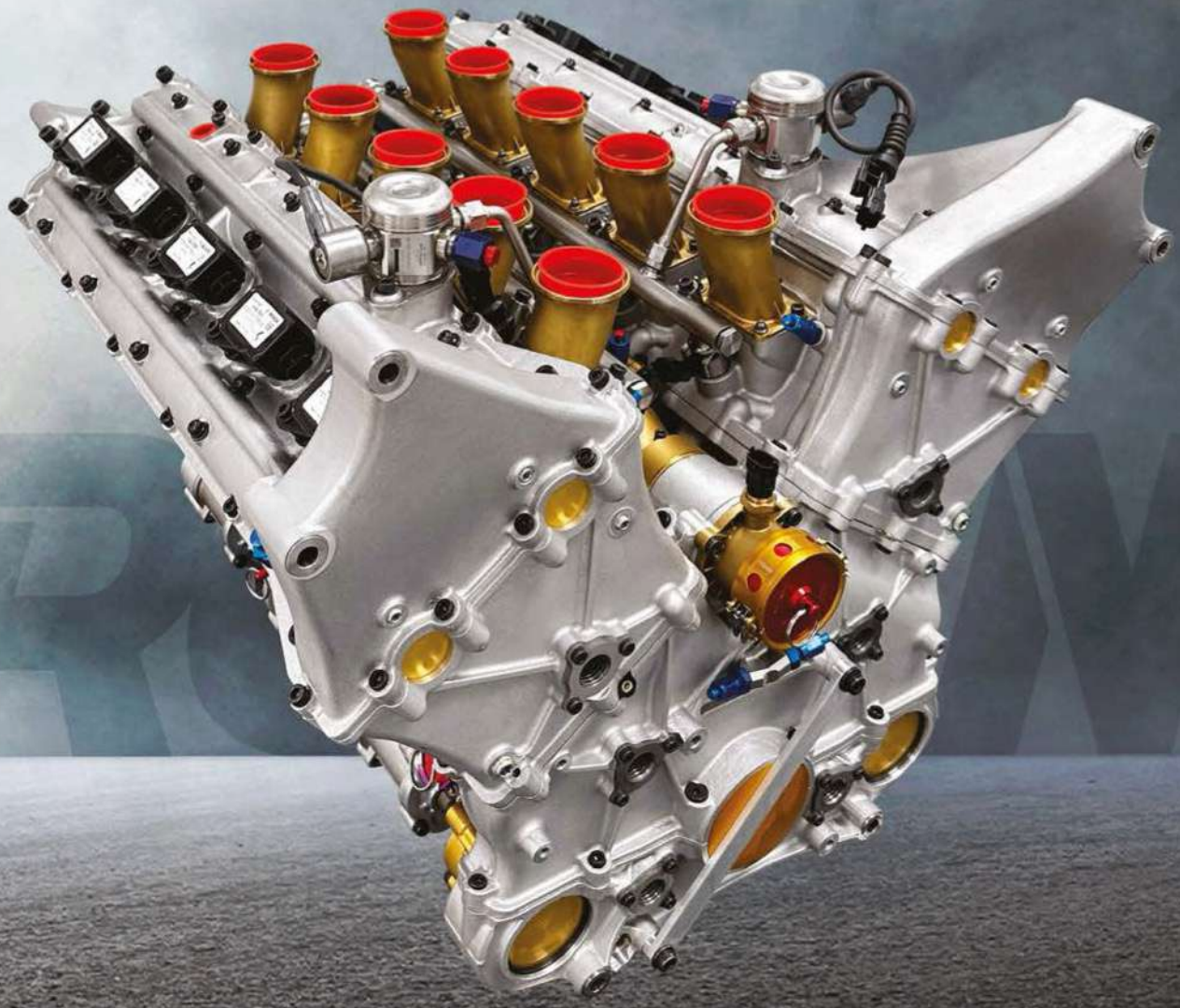
Power unit	Ferrari 066/10 1.6-litre V6 hybrid
Chassis	Carbon fibre and honeycomb composite structure
Bodywork	Carbon fibre
Transmission	Ferrari servo-controlled, hydraulic, limited slip differential with semi-automatic sequential and electronically-controlled gearbox; quick shift (eight gears, plus reverse)
Dampers	ZF Sachs / Öhlins
Clutch	AP Racing
Brake system	Carbon fibre disc brakes and pads; six-piston calipers
Wheels	BBS
Tyres	Pirelli
Fuel tank	ATL
Seatbelts	Sabelt
Weight	798kg



Among the significant changes from VF-23 include a deeper undercut on the sidepods and re-profiling of the inlets and crash structure

A lot of development has been done on the car's cooling systems. Visible from the outside is the wider intake above the driver's head

4.0L V10



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Correcting that mismatch is high on the agenda for the VF-24 and Haas hammered that point home when it prioritised long runs during the pre-season test in Bahrain, where the team also clocked the most laps.

'Probably the characteristics of the car last year were not the best,' admits De Zordo. 'It performed very well in certain conditions, but in others it had big losses. This made it a lot more difficult to drive.

'When you have new tyres, it covers some of these bad characteristics and makes it easier for the drivers.'

Haas wanted to make the VF-24 more stable and predictable for the team's drivers, Nico Hülkenberg and Kevin Magnussen, who are in their second season as team mates.

'This is a big help for the tyre,' De Zordo notes. 'At the same time, there is also driving style and how you manage [it]. During the last year, we improved a lot and understood better how to do [that]. Only as we improve that, as we [improve] the general performance of the car, the others are making improvements more than us.

'Even in the last part of the championship, when we understood better how to use the tyres, we lost some competitiveness, and the results didn't come. So we are working this year to put both together.'

Long running

Signs of progress in that quest were observed at pre-season testing, which garnered a more positive assessment of the VF-24 from Komatsu, at least compared to his distinctly downbeat opening gambit.

Haas used the first two days to focus on long runs and the car showed decent consistency, at the expense of being several seconds off the pace. This approach required some mutual understanding within the team so no alarms were being raised when other teams surged ahead in the times.

The VF-24's first low fuel run of the year didn't come until the third and final day of running, but this was a bonus as it was initially unclear whether it would happen before the Bahrain Grand Prix weekend.

'Last year, I just feel our base car was not consistent enough,' says Komatsu. 'Whatever we did – car set-up or driving – after five laps, the tyres were dead. Whereas with this year's car, I feel the baseline is just about good enough [and] consistent enough so we can actually manage the degradation. I think it's a good step forward.

'I'm not saying our baseline car is fantastic. It's not. You can see in the high speed we are still lacking lots of downforce, but at least it's a consistent pace that the drivers, Kevin and Nico, know they are getting every single lap.'

Komatsu added that the VF-23 tended to be inconsistent in its cornering and could get 'nasty' depending on the track conditions.

The VF-24's rear end retains the same layout and engineering concept as VF-23, and Ferrari, which supplies the team's power unit

The new car's brake and suspension revisions have contributed to a tighter, more stable platform and increased mechanical grip

'Last year, I just felt our base car was not consistent enough... Whereas with this year's car, I feel the baseline is just about good enough and consistent enough so we can actually manage the degradation. I think it's a good step forward'

Ayao Komatsu, team principal at Haas F1

'This year's car is behaving in a predictable manner,' he continues. 'Yes, we are still lacking downforce, especially at high speed – and balance in medium or low-speed corners – but I don't think it's got nasty characteristics.'

Earlier upgrades

Haas is continuing to work through its off-track testing allowance of wind tunnel sessions and CFD items, which is the largest of all teams due to its 2023 finishing position.

These tests were used to set the VF-24's initial design and will continue throughout the year. The current plan is to install a major upgrade at a much earlier point in the campaign, rather than waiting until a much later point as Haas did in 2023.

The pushrod front suspension of the VF-24 also carries over from last year and has similarities to what appeared on the previous season's car, although Haas has worked on the aerodynamic side

De Zordo has made it clear he expects the VF-24 to undergo significantly bigger developments than its predecessor did.

'Last year, in the first part of the year, we hoped to find more performance,' he admits, 'but in the second stage [we didn't], and then it took a lot of time to change direction.

'This year, everything seems to respond a lot better than last year. So the feeling is that we can keep it going and develop it more.'

As a Ferrari customer, Haas uses the Italian manufacturer's power unit and gearbox. It has also followed Ferrari in keeping the same suspension layout of pushrod on the front and pull rod on the rear. The front suspension looks similar to that used on the VF-23, although the shapes of the arms have been adjusted for aerodynamic qualities. The rear suspension has also received fresh attention.

'It's a lot tighter in the bottom part,' De Zordo explains. 'It gives you freedom in the design of the diffuser. It is also better for all the winglets you have in the brake duct. Also, how it works mechanically. It should have a tighter functionality of the suspension itself.

'You can have something more from aero, but at the same time you can have something more mechanical. It's all welcome.'

'The best thing I am seeing now is the two structures of Italy and the UK are working a lot more together. We can feel the benefit'

Andrea De Zordo, technical director at Haas F1

Despite the management re-shuffle occurring shortly before the new season started, De Zordo is already noticing some differences in the way Haas operates. The team has an unusual set-up, with headquarters in North Carolina, a Maranello design office for aerodynamics and CFD simulation, and a forward base in Banbury, UK from where its race operations are led.

'Everything happened very fast,' says De Zordo. 'We are still making some changes now and looking for people in some positions. The best thing I am seeing now is the two structures of Italy and the UK are working a lot more together. We can feel the benefit.'

Komatsu's appointment as team principal has placed engineering at the forefront of the Haas F1 operation. Steiner came from an engineering background, but arrived with prior team management experience, while Komatsu started as a performance engineer with BAR before stints at Renault and Lotus.

Working benefits

'For sure, they are two different people,' says De Zordo. 'Ayao is a lot more technical, so is even more involved in what is happening. The very good thing I'm seeing is they are putting a lot of effort into letting people work together. There is a lot more discussion and involvement with each other in deciding the directions to take.'

Time will be required for the engineering-led management structure's effectiveness to be properly judged, but can Haas afford another season as the last-placed team?

Andretti's plans to join F1 with Cadillac recently hit a bump when the FIA rejected its proposal for entry in 2025 or '26, but the two American powerhouses have not given up. Haas will be keen to pick its heels up quickly to keep proving its competitive value, and the VF-24 looks to be a decent starting point.

ASTON MARTIN

Ad-Vantage Aston

Aston Martin has introduced an evolution of its Vantage for the 2024 GT3 season, based on its new road car that was launched mid-February

By ANDREW COTTON

Aston Martin has been involved in GT3 racing since the start of the category with the DBRS9 model through to the Vantage that shared a platform with a GTE car. Now, for the 2024 season, as the GTE category has finally died off and the GT3 regulations have evolved under the guidance of the FIA, the big prize has shifted from the 24 Hours of Spa to Le Mans, where Aston Martin teams will compete with the Vantage GT3 Evo.

Launched alongside Aston's new Formula 1 car in mid-February, the GT3 update is one of three headline projects for the British manufacturer.

The Vantage will compete in the FIA World Endurance Championship this year, and next year will be joined by the Valkyrie Hypercar. Aston Martin has already started systems testing on that car, in January 2024, and says it will begin full car testing mid-year.

The Vantage GT3 Evo is the first product since the collaboration between Aston Martin Racing (AMR) and Aston Martin Performance Technologies (AMPT). The idea of this link between the two entities is to feed technology and learning into the next generation of road cars. That in turn, will then feed back into the racecars.

For now, though, while the new racecar is still based on the 2018 Vantage roadcar, it is an evolution with some significant visual and mechanical differences that the team believes will improve overall performance. As an Evo, the fundamental components have been carried over, including the tub, engine, gearbox and differential. The old car, run by existing customer teams, can be updated to carry the new parts, although there will, of course, be compromises in that scenario.

Customer first

Founded in 2021, AMPT was essentially Aston Martin's response to Red Bull Advanced Technologies. However, it has not replaced long-time AMR partner Prodrive, which continues to undertake GT3 assembly duties and provide spare parts support.

The Vantage GT3 Evo is the first product since the collaboration between Aston Martin Racing and Aston Martin Performance Technologies

Nonetheless, AMPT's involvement means the link between racing and production will be stronger than ever.

'My particular involvement is to ensure it is steered in the right direction for the values of Aston Martin, which is that we want customer racing. We want it to have strong pro-am performance,' says Adam Carter, head of endurance motorsport at Aston Martin.

'The guys at AMR are more than capable of designing and developing a car; it's about the direction of the specification of the car, which way you want to go with it.

'There are always decisions [to be made]. Racecars are always the sum of the parts. It's about making many decisions – some of them will be compromises – but it's getting to the correct position, which is what dictates the performance of the car.

'People are ultra competitive, and often things like building the fastest car, or the fastest car for an individual, is not necessarily the same as building the fastest car across a whole market. My job title as engineering director is to direct rather than micromanage, to steer and dictate what happens, and just to hold the general path and make sure we hit the main attributes required of the car.'

To improve serviceability and use on track, the rear wing has been made modular and easier to adjust

Louvres in the tops of the front wheelarches evacuate high pressure air to reduce lift

The car meets the performance windows for FIA GT3 and LMGT3, with minor variations in the diffuser

Extensive testing has prepared the car to work on the differrent tyres used in GT series

The car's aerodynamics, set-up geometry and dampers have been given a comprehensive overhaul to make the car more benign and predictable for amateur racers. Power still comes from the existing 4.0-litre V8 engine

Although the Evo version was kept tightly under wraps during the December Balance of Performance test hosted by IMSA in preparation for the Daytona 24 Hours, it was hard to ignore the car at the race itself. The updated model finished just off the podium in GTD Pro, in fourth place behind Ferrari, Porsche and BMW.

Conservative approach

This is the first Aston Martin to be built to the current GT3 regulations, which are prescribed rather than decided by committee. The decision to formalise them in this way has led to some wild solutions, such as the Ferrari 296 and Ford Mustang. However, rather than take full advantage of the new regulations, Aston Martin has taken a conservative approach.

The big difference between the old and the new car comes in the suspension design, coupled with new aerodynamics, both of which have received an extensive overhaul to make the car more driveable and competitive in a wider range of circumstances.

Keeping the existing 4.0-litre V8 engine that has been originally sourced from Mercedes, and keeping the same chassis means Aston Martin can offer the upgrade kit to existing customers, while homologating the package as an 'Evo' kit means all the replacement parts meet the new regulations. Had Aston Martin produced a whole new car, the entire car would have to comply with the new rule set, including safety equipment, which would have been a major task.

For while the old car, which raced in both GT3 and GTE spec, won multiple races and championships, there were some inherent flaws in its design that the team has been working on.

Further improvements have been made to serviceability, which is key to BoP racing. The rear wing is also now easier to adjust and a modular system is in place at the front with a quick release frame.

Deep diving

Previously, the Vantage has been prone to 'diving' under braking, with the weight transfer forward on the brakes, so the development package has focused on stabilising the car in the approach to corners, and around them. That has led to more benign handling designed to make the car more predictable.

'These new generation GT3 cars are more dependent than ever on aerodynamic performance, so we wanted to make the car more stable under braking,' confirms Gustavo Beteli, Aston Martin Racing's head of performance.

'The old car would dive a lot under braking so we had to try and control the pitch with the rear suspension set-up. But this meant it was stiff, which made it quite snappy, and also overworked the tyres.

'Working heavily on damper tuning, we have found a much better balance with the new car so we can generate the downforce [required] without compromising the set-up. The result is much improved progression and greater stability in all conditions.

The [revised] suspension design, coupled with new aerodynamics… make the car more driveable and competitive in a wider range of circumstances

'It also works the tyres more evenly, so teams have more options on the strategy.

'The throttle pedal is also easier to modulate. It is not about the fly-by-wire throttle, it's the stroke of the throttle. If you can control that rear slip, you can control tyre degradation, and so on.'

While the aero has been heavily modified, with the new nose design from the production car allowing for improved airflow to the brakes to help cooling, it's under the skin where the car has changed the most.

'There are around 85 sub assembly changes, so it's quite significant,' says Carter. 'The bodywork is evolved to reflect the new road car product, but it's also changed to meet the performance window for FIA GT3 and [Le Mans], so pretty much the same car sits between the two performance windows.'

Indeed, the only real difference between the two cars is the strakes in the rear diffuser that guide air cleanly out of the rear of the car.

Window of opportunity

The nose itself is a large, one-piece clamshell made from carbon fibre. Its quick release design facilitates rapid removal and replacement in the event of accident damage. It houses a full-width laser light and a shorter splitter, which moves the centre of pressure rearwards to reduce pitch sensitivity and aid stability. Large louvres in the top of the front wheelarches evacuate high pressure air to reduce lift, while louvres over the rear 'arches allow high pressure air to escape from the rear, reducing drag.

'It's acknowledged that whilst the previous generation GT3 Vantage was competitive, its consistency of competitiveness was not always there with a small set-up window,' admits Carter. 'It could be very competitive,

The updated car made its debut at the Daytona 24 Hours with three entries across a pair of teams. Two cars retired, but The Heart of Racing managed to finish fourth in GTD Pro

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and then an amateur driver would go to a different track, with different temperatures, and be off the pace.

'The car was difficult and nervous at turn in. It's one of the biggest issues, that braking and turn in phase, the combined transition. It would either be pinned, or it could be a bit of an animal and sometimes that could change during the event.'

Essentially, the team has widened the car's operating window, reducing peak performance in certain areas to produce a better, faster, more predictable car. With the Aston expected to compete in a variety of race series in different countries, using alternative tyres and fuel, this is a major advantage to the programme.

'With a car that's more benign by nature, when you change a variable such as tyres, it's always the sum of the parts,' continues Carter. 'If you have something that is peaky underneath and you throw a change at it, it's rarely going to make life easier, or better. That's the thing that just makes it easier to operate across four different championships.'

Those championships include IMSA, WEC and the GT World Challenge. Each series uses different tyres, which makes a more adaptable set-up far easier to manage.

The development team completed extensive testing on the different tyres, including a 30-hour test in late 2023 to prepare it for the different rubber and fuels.

Despite carrying over the engine from the previous model, further work had to be done to make it perform comparably on the renewable fuels now used in all major endurance racing series, including those from TotalEnergies in WEC (which also uses torque sensors) and SRO series, and VP Racing Fuels in the US championships.

'We have been able to do some fundamental things on entry that allow us to exploit some performance on the exit as well'

Adam Carter

The end result is a slight change in the mapping for the cars running in the different series.

'It's an engineering challenge,' confirms Carter. 'It's complicated and expensive and you always want to try and keep things the same because of reliability and durability.'

Wide track

The switch to KW suspension systems was one of the biggest changes to the car. The team remained with Alcon for the brake supply, preferring to change as little as possible in that system, but the suspension had to change to increase set-up options for teams.

The team made full use of the fact that the new production Vantage has wider bodywork than the previous model. Consequently, any team that fits the new suspension into an existing car will 'have bits that stick out', according to Carter. It can be done, but it might not be the most elegant solution.

KW's five-way damper works in conjunction with the rear differential to improve the full corner experience with the car.

'I would say the biggest change is the aero package, and the combination of set-up geometry and dampers to stabilise that entry phase into a corner,' says Carter. 'That easier entry opens up the set-up window to make the car more benign, and that then led us to being able to do preferred things with the rear of the car on positive torque traction.

'It has made the through corner balance more compact, tighter and more predictable. We were fundamentally putting on a plaster to try and overcome issues on [corner] entry, which then hurt you elsewhere. What we were compromising on entry, we also compromised on exit. Now, we have been able to do some fundamental things on entry that allow us to exploit some performance on the exit as well, which is better for tyre life, for example.'

Better corner exit speeds should, says Carter, help with the ability to overtake as the car will hit either higher top speeds or terminal velocity earlier than a car that was hampered throughout the corner.

Much is expected from this car, and Aston Martin expects to sell 30 units in 2024. Not all of them will race, but it's certainly a profit centre for the manufacturer.

The Evo racecar has leveraged the production car's new nose design to improve both brake and engine cooling

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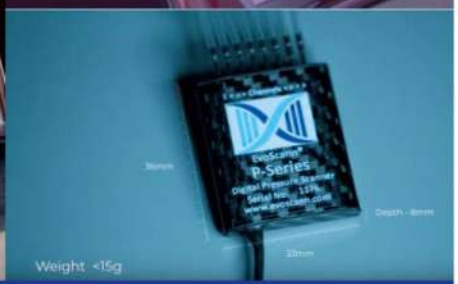

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A Mini adventure

Formula E has a new electric support series that's designed to bring young drivers up to speed... touring car speed

By LAWRENCE BUTCHER

'For the young drivers, it's a modern, good-looking car that everyone knows. And size-wise, it couldn't be much smaller and still fit the battery in, but it doesn't need to be any bigger'

Fredrik Lestrup, founder of Lestrup Racing

Formula E last had a support series with the somewhat bizarre Jaguar I-Pace eTrophy. Featuring an arrive-and-drive format, the races had a VIP driver each round and, to be honest, as proficient as the I-Pace is, it was never really cut out for street circuit racing.

Those who were hoping for some old school, door banging, touring car-style action were left wanting. It went the way of the dodo in 2020 and, in the intervening years, FE has been the sole billing at every round.

However, for 2024, the NXT Gen Cup will make an appearance at the four European races on the FE calendar and promises an altogether more engaging prospect. The brainchild of Fredrik Lestrup, founder of Lestrup Racing, the NXT Cup has already run a successful full season through 2023 and is aimed squarely at young drivers looking to step up to TCR-level racing.

Lestrup readily admits he was a late starter in motorsport, but that has not held back his ambition. *Racecar* decided to find out more.

The covers are pulled off one of the new NXT Gen Cup racers, built up from a Mini Electric. The idea is to offer an accessible launch pad for new driver talent, while also maintaining road relevance

'I started [racing] when I managed to find the funding, I started very late,' says Lestrup. 'And I did the unique categories all the way up to the highest category in Sweden. I also went to Germany, raced in Australia and raced all around the world, which was my goal.

'I had a good career. I did what I wanted to do, but never managed to be paid, or be a factory driver. So, in 2013, I made the decision to start a team instead.'

Global stage

Lestrup Racing Team has run TCR cars in Europe and GTs on the global stage, but reached a point where its owner knew a change of direction was needed.

'We felt we had to make a difference. We struggled to find finances, and we tried to always have young drivers in the team. But they also struggled to find the funding. So, we thought, okay, it's time to do something, be a bit more relevant to the road manufacturers and create something new.'

That something is NXT Gen, where a field of 20 young drivers in identical, all-electric hatchbacks battle it out over 15 to 17-minute races on tracks across Europe. However, reaching the point where they can join the Formula E circus has taken Lestrup and his team (only five at the factory, but growing to 40 on race weekends), over half a decade and several false starts.

The starting point for the NXT Gen car is the Mini Electric, though this was not always the plan. The team started out working with the Volkswagen ID.3 platform, and had long-running discussions with the German manufacturer. But, with VW's almost total withdrawal from racing activities following 'dieselgate', an alternative was needed.

The team did talk to another constructor, but it only had SUV EVs, so thoughts turned to converting one of its ICE cars instead.

'Then from the board of the company, they said we were not allowed to race with an electrified combustion car, because it was not relevant to their product,' recalls Lestrup.

For those looking to race small, hatchback EVs, there is surprisingly little choice, with most manufacturers going the crossover route.

'We struggled to find a suitable car. It's a junior championship, so we don't want a big or heavy car. We went through BMW and ended up at Mini. For us, it's the perfect car.

'For the young drivers, it's a modern, good-looking car that everyone knows. And size-wise, it couldn't be much smaller and still fit the battery in, but it doesn't need to be any bigger.'

The initial plan was to use the production car powertrain, and the first Mini arrived for evaluation in 2021, but the team quickly found it wasn't up to the task of competition.

Power up

'We took it to a racetrack, mounted sensors on the inverters, cooling system etc. We did one and a half laps and lost 40-60 per cent power,' recounts Lestrup. 'The third lap was a minute slower than the first, so we loaded the car and went home, realising it was not possible to do this with OEM components.'

It was not just the capabilities of the stock parts that was found wanting: the lack of access to their control system would have been a further hindrance, buried as they are on road cars in proprietary, locked software.

A field of 20 young drivers in identical, all-electric hatchbacks battle it out over 15 to 17-minute races on tracks across Europe

The car itself, however, was deemed capable. So began a process of choosing partners and assembling a pure, motorsport-bred powertrain to fit into it. As Lestrup highlights, there are only four stock electronic parts left on the car beyond the lights: the wiper motor, throttle pedal potentiometer, power steering and the cooling fan.

Proven suppliers

Key to the success of the project is Lestrup's choice of proven suppliers for the powertrain components. In effect, the Mini runs a variation on the drivetrain found in the RX2e cars of the World Rallycross Championship. This sees the battery supplied by QEV Technologies, with an inverter from Cascadia Motion and axial flux motor from Magelec.

Like the RX2e cars, the 30kWh battery is located on the floor, next to the driver, while the motor and inverter are placed up front, in the same location as the production units. The inverter, however, is a newer variant than that found in rallycross.

'It's half the size and half the weight,' notes Lestrup. 'We also wanted a DC-DC converter for the 12V supply, so we wouldn't have to charge the [12V] battery between sessions.'

The standard radiator is retained and is more than up to the powertrain's cooling needs, as is the stock fan.

'That means we can keep the standard coolant tanks, along with all of the brackets,' continues Lestrup. 'We just have an external pump to actively cool the motor, the inverter and the DC-DC.'

Impressively, the battery is not actively cooled during races, relying instead on the thermal mass of the pack (it is not cooled in rallycross either, but that is short, four-lap heats, not 15+ minute races). The batteries can be pre-cooled and, during a race, the pack temperature will rise by around 30degC.

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When the production electric powertrain was found lacking, Lestrup stepped up to a 30kWh battery from QEV, along with an inverter from Cascadia Motion and axial flux motor from Magelec

'We can have plenty of headroom built in and can run them up to around 60degC without any loss in power,' states Lestrup.

Neat packaging

The front drive system does feature a gearbox, but it is simply a drop gear arrangement from French supplier, 3MO, and is fitted with a traditional, plate-type limited slip differential.

'We wanted a proper differential with pre-load you can adjust, and the ramps for braking and acceleration. This is because we wanted a car that is educational for drivers so, when they step into a TCR car, they are familiar with how a differential behaves,' explains Lestrup.

In a similar vein, the braking system features a twin master cylinder with adjustable bias and a readout on the dash showing brake pressures, just as would be found in a higher-level racecar.

Packaging the new drivetrain into the Mini was a relatively straightforward process.

'We have a cut out and reinforcements in the floor for the battery. The motor mounts locate to the standard fitment points, so it's all quite simple,' confirms Lestrup.

With the battery mounted in a different location to the production car, it could be assumed that extensive work would be needed to correct the weight distribution, but Lestrup says that was not the case at all.

'We have 58 per cent on the front axle, which is pretty ideal from a front-wheel drive perspective. We had a little bit of space forward and backwards where we could place the battery if needed.'

The battery itself weighs in at 255kg, yet due to the placement of other components in the chassis, with a 75kg driver in the car, there is only a 50kg excess on the passenger side.

'If we had a fuel cell in the middle at the back, the side-to-side weight distribution would actually be worse,' says Lestrup.

Having some right-side bias is no bad thing in this instance. With all the tracks the series visits being clockwise, the extra weight on the inner wheel is welcome.

'We wanted a proper differential with pre-load you can adjust, and the ramps for braking and acceleration. This is because we wanted a car that is educational for drivers, so… they are familiar with how a differential behaves'

Fredrik Lestrup

Furthermore, the c of g is very low compared to a combustion-engined car, only slightly above the floor level where the battery cells are located.

Thermal challenge

The greatest challenge the team had to overcome was keeping the motor within acceptable thermal limits. Over the development of the car, it has been able to steadily increase the available power through careful refinement of the mapping.

'We overheated in the beginning,' admits Lestrup. 'Our limitation was always that we overheated the motor. I would say we spent most of the testing finding a mapping where we can use the power without overheating the motor. Obviously, that meant figuring out what operating conditions were building heat in the motor, and what was not building heat, because we could not extract more heat as it is generated in the windings.'

High motor speeds led to increased temperatures and, with a single gear, this correlated with vehicle speed.

'At high speeds, you're using a lot of energy and making a lot of heat so, as speed increases, we *decrease* the power.'

Each car is equipped with three rotary controllers, which cannot be changed by the driver. These are to adjust peak power, the motor rpm at which power starts to be throttled and the rate of decrease.

Even with the 255kg battery sited in the passenger compartment, weight distribution is said to be pretty much ideal for an FWD car

The motor and inverter are sited up front, in the same place as the production counterparts, and much of the cooling pack is standard

A plate-type LSD and adjustable bias brakes were important elements of the car to give young drivers the chance to learn their craft

'At high speeds, you're using a lot of energy and making a lot of heat so, as speed increases, we *decrease* the power'

Fredrik Lestrup

The third rotary controls regenerative braking, which can be set to up to 100kW, and also contributes to heat build up in the motor. These controls allow for motor output to be tailored from track to track, depending on the length of straights and other factors, to ensure the desired thermal parameters are respected.

An interesting aside relating to energy recovery is that the original brakes on the Mini actually had to be downsized.

'Another thing we struggled with in the beginning was, since we were using so much regen' on the front axle, the brakes were too big,' reveals Lestrup. 'We never got temperature in the brakes, so scaled them down and still didn't manage to get enough temperature in the pads.

'In the end, Alcon, who built the braking system for us, had to develop a special brake disc with really thin walls for us that lets us quickly build temperature, as well as a specific pad compound.

'This is important because we don't do an out lap where we warm up the car, in order to save energy. We take the slowest and shortest way to the grid, and then we start the race. That means that braking for turn one, the car is cold; everything is cold, tyres, brakes, engine.'

After a full season of racing and refinement, Lestrup is happy that the team has extracted the most power it can reliably from the powertrain, with a peak continuous output of around 185bhp (up 10bhp on 2023). Drivers also have a push-to-pass function available twice a race, for five seconds each deployment, which ups this by 60bhp and does not tail the power off at higher speed, allowing for drafting overtakes to be executed.

'We've managed to control the temperature build in the motor, so state of charge is the only limitation at the moment. But the 30kWh we have now is perfect. For a junior car, it's enough.'

Performance parity

An overriding concern for Lestrup and his team was ensuring performance parity across the field, and giving drivers a true education in order to improve their skills.

Beyond mechanical parity, NXT Gen also encourages the sharing of data between competitors. In fact, it is mandatory.

With a peak continuous power output of 185bhp, the cars are fun and engaging to drive. There's also a push-to-pass function available twice a race, for five seconds, adding a further 60bhp

'It was really important for us to have a proper data logging system so we can educate the drivers. We share all data between the drivers at the end of every session, so everyone can compare,' explains Lestrup. 'If you are the best, obviously the other drivers see what you did, but it is a way for us to help everyone to become quick.'

The comprehensive logging capability also gives transparency of car performance, and here, the electric platform really comes into its own.

'No one has ever complained about the cars having unequal performance, and we can't see the difference in the data. If you have a combustion engine car, you can see the top speed and acceleration is always a few per cent between cars, but here we can't see any difference. That's a big, big benefit of the electrification.'

Furthermore, with 20 cars to keep tabs on, the team needed a quick means of checking performance across the field, so has developed its own data analysis tool to make rapid comparisons.

'We can quickly figure out if a car is under or over performing,' asserts Lestrup.

There is scope for some chassis set-up-based performance gains, though the changes that can be made have deliberately been kept to a bare minimum. For example, all the cars retain the majority of their standard suspension components which, with the base car being the John Cooper Works variant of the Mini Electric, are already performance orientated.

The stock hubs, subframes and suspension arms are retained, as are the anti-roll bars, though the standard bushes are replaced with polyurethane items from Powerflex.

The team is part owned by Kent Öhlin, so it is no surprise to hear that his company's dampers are used, in conjunction with camber adjustable top mounts sourced from Swedish supplier, Millway.

'The base of the Mini is freaking good to start with, and then adding the adjustments of the camber and so on, it's *really* good. But from a set-up point of view, we make sure all the cars are identical,' says Lestrup.

Drivers can make some tweaks – fine damper adjustment and tyre pressures, for example – but that's it.

Of course, more performance could be achieved with a more edgy set-up - one the faster drivers in the series might be able to exploit - but that would be unnecessary given the ethos of the championship.

Scratch built

Looking at Lestrup and his team's efforts with NXT Gen, it is hard not to be impressed. They have assembled a fully functioning race series from scratch, and are able to regularly field a grid of 20 cars. The series also carries all its infrastructure with it.

'We have nine trucks for each event; two for the cars, two trucks with the racecars, two with the chargers, spare parts equipment, plus we have a few trucks with all the tents we use, the power banks etc. It's quite a big logistical operation.'

'It was important for us to have a proper data logging system so we can educate the drivers. We share all data between the drivers at the end of every session, so everyone can compare'

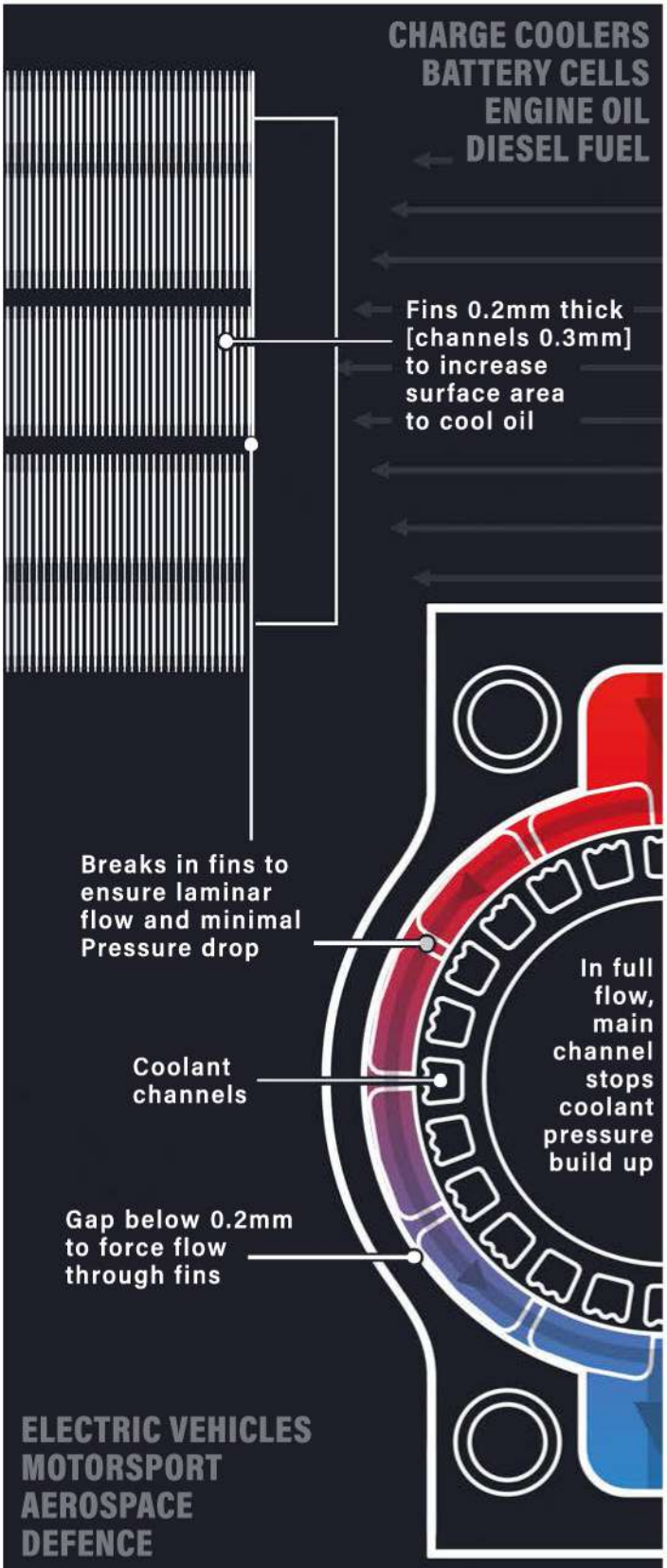
Fredrik Lestrup

The battery banks, consisting of containers equipped with 330kWh of capacity, are charged slowly at the track and then used to replenish the cars between sessions as few tracks would have the necessary electrical supply to support this.

With the Formula E deal, NXT Gen is moving up a gear, promising to add an extra layer of entertainment to the flagship EV series. The timing has also been opportune.

'The series would not have survived staying in Scandinavia, from a finance perspective, because it's still too expensive to build these cars. That's the biggest downside of EV,' says Lestrup. 'We needed to get out on the big scene to show what we can do and to attract the right partners and finances. So, we took a little gamble, and now we're out there.

'I'm not sure Formula E actually understands what we're coming with, but it's 20 young drivers, with small, nice racecars, and a good show, both on and off track.'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Avon's parent company, Goodyear-Dunlop, made the decision to cease producing race rubber under the British brand name in 2023

Tyre where?

In the wake of Avon's withdrawal from motorsport, worries over tyre supply dominated UK paddock chat in 2023.* Racecar *investigates how things stand now the dust has settled

By MIKE BRESLIN

It's not unusual for engineers and drivers to talk about tyres. Whether it's blaming them for a lack of pace, complaining about not having enough of them, or worrying about their condition. But in 2023 there was more tyre chat than ever at British circuits when it became clear that one of the major players in the race rubber industry was going to cease manufacturing its products.

That major player was Avon, a company with a very long history of providing tyres to racing, including stints supplying Formula 1 teams in the 1950s and early '80s. More latterly, it's become better known for its national motorsport involvement, building up an enviable reputation in the British Hillclimbing Championship and in Formula Ford, amongst many other series.

However, in 2022, Avon's parent company, Goodyear – through its 2021 acquisition of the Cooper Tyres group, which had been Avon's owner since 1997, announced it was considering closing the company's Melksham, UK plant.

Sadly, that has now happened, with the last tyre being manufactured there at the beginning of December 2023.

In the short term, this has not proven too much of a problem because BMTR, the Birmingham, UK-based tyre wholesaler that distributes much of Avon's motorsport product, has access to enough stock to supply its regular customers. But for how long?

'Avon Motorsport is no more,' confirms BMTR operations and motorsport director, Paul Nicholls. 'What's left of it is now a bit chaotic, but we've done our best to try and give a supply line to all the championships we've always had agreements with, that we've always stood by and supported.

'So, HSCC [Historic Sports Car Club], British Hillclimb, Midland Hillclimb and Formula Ford.

'It's the long-term supply of slicks, in particular, that is the real concern across UK motorsport'

Giles Groombridge, competitions secretary at the 750 Motor Club

Tyre fitters at work at Prescott last season. UK tyre wholesaler, BMTR, says it has enough Avon rubber in stock to supply competitors for the 2024 British Hillclimb championship, but not indefinitely

Rather than run the risk of running out of tyres mid-season, Formula 1000, a one-make series for 1.0-litre bike-engined Jedi single seaters, made the decision to replace Avon slicks with similar tyres from Hoosier for this season

They're very much part of what BMTR has done, and will continue to do.

'We've lost a few things along the way, but ultimately I think the lion's share of competitors will be okay.'

Hoosier daddy?

One championship that has had to source new rubber for 2024, though, is spec bike-engined single-seater series, F1000. As the Avon crossply slick it used on its Jedis is no longer available, the series has switched to Hoosier tyres, and the American tyre firm now seems to be in pole position to pick up much of the slack in the UK market.

BMTR, for example, now stocks Hoosiers.

Hoosier already has a foothold in the UK, supplying championships such as Formula Vee, which it has been involved with for some years. Formula Vee is, of course, similar in concept to Formula Ford, and James Beckett, who organises the blue riband Walter Hayes Trophy for FF1600 and the United Formula Ford Championship – from this year the single national championship – says those involved in Formula Ford are indeed looking at Hoosiers, as well as another tyre option from Goodyear-Dunlop.

However, despite there being only one national championship this year, FF1600 is a complicated marketplace.

'BMTR have enough stock [of Avons],' says Beckett. 'The tyres for 2024 were all produced last year, so Formula Ford is covered [for this year]. Moving forward, though, BMTR is keen to stay involved in Formula Ford, so is currently looking at other options.

'There's a tyre in development by Goodyear-Dunlop, for example, so there are options for next year. The decision hasn't been made yet because there are lots of stakeholders across Formula Ford who run different championships and different series. I organise the Walter Hayes Trophy and United, but then there's also the BRSCC [British Racing and Sportscar Club], the HSCC and Castle Combe. That's just in this country.

'Formula Ford needs to be on a single tyre though. You can't have a tyre war within Formula Ford. It would be bad news if that happened. So, it's just a case of everybody working together and coming up with an option to go with. And that is what's happening at the moment.'

Both the Hoosier and Goodyear-Dunlop products are good options, Beckett believes.

'Goodyear-Dunlop, they were the parent company of Avon, so the compound might well be similar,' he says. 'And the Hoosier is a well-known Formula Ford tyre that can run in the east of America. So, if it can run there, it will certainly be able to run on a cold, damp day at Donington Park.'

'We have written our regulations so that if there is a tyre shortage, we can seek alternative tyre sources for that particular series or championship'

Andy Dee-Crowne, CEO of the Historic Sports Car Club

Avon supplied two types of tyre to Formula Ford, its cut slick-style ACB10 being the rubber of choice on more modern FF1600 racecars

Older Formula Fords, like those that race in the HSCC's classic or historic championships, use the more traditional treaded Avon ACB09

Avon manufactured two tyres for Formula Ford, the ACB09 and the ACB10. The former is a fully treaded tyre like the Dunlop it replaced in the '90s, now used for historic and classic FF1600. The latter is a sort of semi-slick, rather like a track day tyre, used for more modern cars. Interestingly, both the options Beckett was looking into at time of writing would be similar to the traditional treads.

'They would put Formula Ford back onto something like the Avon ACB09,' he says. 'I'd like the series to run on a more traditional tread pattern… I think probably it will be one tyre across all ages of Formula Ford, which I also think would be beneficial.'

Rubber check

The HSCC has also used Avons for many of its championships and its CEO, Andy Dee-Crowne, admits the recent instability in the tyre market has been worrying.

'Am I concerned? Yes, of course I'm concerned,' he admits, 'but we have written our regulations so that if there is a tyre shortage, we can seek alternative tyre sources for that particular series or championship. And of course, Motorsport UK would have to make dispensations for that.'

This is because the UK governing body has a strict protocol when it comes to allowing a tyre to be used in motorsport, which is operated through its own advisory panel.

'We manage eligible tyre lists for various forms of the sport,' says Ian Smith, technical director at Motorsport UK, 'and we do that on an annual basis with a cross section of tyre manufacturers. All the tyres listed in the yearbook in Section L are managed through a panel, and each of the manufacturers that have tyres on the list sit on that panel.

'Part of the governance of that process is to make sure there's continuity of supply, and to protect competitors that may have enthusiastically bought a stockpile of tyres. If there's going to be any changes to the eligibility of those tyres, they're phased in over a proportionate time so people don't get stuck with tyres they can't use.'

That last point is not lost on Dee-Crowne: 'The problem comes when, let's say, we're halfway through the season on Avons, and suddenly Avons are not available, so we have to change tyres mid-season. We then have the issue that some people will have tyres they spent a considerable amount of money on that could then be unusable.

'We have to be very careful about how a mid-year change might impact our championships, though we're not there yet.'

Historic motorsport also has very particular requirements from its tyres, which means the HSCC has to be especially careful when selecting rubber for its championships.

Grip issues

'The one thing you can say about a historic car is it wasn't developed to absorb the stresses that modern tyres put into it,' notes Dee-Crowne. 'So the modern compounds, which are more grippy, could cause you issues with suspension, for example.'

It's the long-term supply of slicks, in particular, that is the real concern across UK motorsport at the moment.

'I think the slicks market, obviously being that much smaller, is more worrying,' confirms Giles Groombridge, competitions secretary at the 750 Motor Club [750MC].

'The stuff that's running on smaller 13in wheels tends to use tyres that are off F4 or F3 cars, that kind of thing. There is an availability of supply there but, if the direction of travel is like it is in F1 and F2, moving to bigger diameter wheels, are people really going to be making this sort of stuff in the future? I don't know.'

Supply of this type of rubber is already an issue in some series, with Monoposto competitors telling *Racecar* last year that it was difficult to source tyres for F3 cars running in the championship.

With Pirelli now choosing to focus on its contracted tyre deals, those wanting slicks for Formula 3 cars raced in series such as Monoposto have sometimes struggled to source them

While BMTR still has a large stock of Avon tyres, at time of writing it looks very likely that a new British company will manufacture Avon-branded race rubber in a European location in the future

A new company called Nova Motorsport Tyres, set up by a former supplier to Avon called SPC Rubber Group, [is] in the final stages of a process to acquire all the Avon equipment and IP from Goodyear

This is partly because Pirelli has stepped back from the wider club scene to concentrate on the championships it directly supports, which tend to require a lot of tyres because of the amount of testing involved.

On top of all this, there was a fire at Hankook's number two plant in Daejeon, South Korea last year, which put pressure on motorsport tyre supply throughout the world.

Super Nova

Sticking with the UK for now, one thing that would sort out all the uncertainty would be if Avon was somehow able to continue manufacturing its motorsport tyres. Surprisingly, as *Racecar* was going to press, this scenario was looking quite likely.

This is because a new company called Nova Motorsport Tyres, set up by a former supplier to Avon called SPC Rubber Group, was in the final stages of a process to acquire all the Avon equipment and IP from Goodyear. As we understand it, the company is also employing many of Avon's sales, technical and engineering staff, including Paul Coates, former head of Avon Motorsport.

The new company is planning to go into production at a non-UK but European location yet to be divulged, and will have a technical and commercial facility in Britain.

'My objective is to have Nova Tyres as the licensed manufacturer of the Avon motorsport brand,' says Paul Hallas, managing director of SPC. 'We will be buying all the stock and we've got about two years' worth of stock in some areas, one year's worth in others. So, we are hopeful there will be no business interruption.'

The question now is, will Nova be up and running in time to fill the gap when the existing stocks run out? Hallas told *Racecar* it could take a year to 18 months before it's ready for production, yet Beckett says he would like Formula Ford – to take just one example – to have a supply in place for 2025 and beyond by June of this year.

'I just hope people will give us a little bit of time to come up with a solution and stick with the brand. I want brand loyalty,' says Hallas. 'That's what worries me the most at the moment, that by the time we're ready, everybody will have moved on. I just hope we are able to avoid that.'

Another question is whether the Avon-branded tyres made by Nova will be the same as those previously supplied, especially as any change in the way the rubber is mixed affects the nature of the tyre. Hallas is confident Nova has this covered: 'Rubber compounding is our game. We're *au fait* with the materials and we have relationships with existing suppliers,' he says confidently.

'The mixing side is something we are familiar with too, and I think the way we mix, in fairness, will give us a stronger technical edge… It will still be the same tyres it always was, because we're getting the moulds, the compounds and the manufacturing IP.'

Niche market

While the situation with Avon has been the subject of much paddock chatter over the past year, other tyre makers have also been reviewing their involvement in motorsport.

'One of the things that all the tyre manufacturers are facing as a reality moving forward is that they need to reduce the complexity of their product portfolio,' says Smith. 'There just isn't a huge amount of commercial sense in producing a very niche product for a very small section of the market.'

Related to this is the trend for larger diameter tyres on road cars, which means there are likely to be far fewer options for smaller diameter racing wheels.

'The whole tyre industry landscape is changing… A motorsport tyre is still profitable, but it depends on what the manufacturer wants to do'

Alan Meaker, technical and motorsport director at Toyo Tyres

'The whole tyre industry landscape is changing,' says Alan Meaker, technical and motorsport director at Toyo Tyres. 'When you consider how many cars these days are produced on 13in tyres, well, there are very few. Most are now 17, 18, 19 and 20in, even on cars for just normal road use. A motorsport tyre is still profitable, but it depends on what the manufacturer wants to do. From our point of view, we're continuing to make 13in to 20in motorsport tyres, as in the R888R.'

Toyo has expanded its presence on the UK motorsport scene in recent times, now supplying the main Caterham championships, for example, in the wake of Avon's withdrawal. It has also stepped in to supply series that are now moving away from Yokohama tyres.

Direction of travel

'We used to have a lot of championships running the [Yokohama] A048, a lot of our production-based stuff,' says Groombridge. 'It was always a really popular tyre, reasonably priced and available in a broad range of sizes. However, Yokohama's direction of travel has gone from a sort of motorsport, track day tyre to a focus on the 17in and above market.

'When we noticed that the smaller 13 or 15in tyres would either not be available, or would be priced more like a 17 or 18in tyre, that's when we had to reassess things, so we switched a number of championships last year to the Toyo R888R.

'It's a great tyre,' Groombridge adds. 'Perhaps not quite as quick as the Yokohama, but the wear rate is very favourable, and Toyo seems to have a commitment to keep making that tyre in the full spectrum of sizes, so it was a logical choice for us.'

The trend for tyres that fit a larger wheel is another issue with historic racecars.

'One imagines that if there was a non-availability of specific tyres for particular kinds of vehicles – say, saloon cars – that we would have to look at regulatory change,' says Dee-Crowne. 'I mean, there could be safety issues, of course, with increasing wheel rim size, but one would hope there would be an alternative tyre one could adopt that would meet all the safety regulations, and cost requirements.

As road tyre trends change, mainly due to the continual movement toward larger diameter wheels, it becomes more difficult to find suitable rubber for smaller wheel sizes, as used on most classic and historic racing machinery

Toyo's R888R has become a popular choice in UK racing in recent years, with the 750 Motor Club now specifying it for a number of its championships, as does Caterham for its three main race series

'If you just take general [roadgoing] historic cars, there is an upsurge in people with these. There's a market out there and it's about who's going to support that market.

'It's the racing compounds that are the potential issue, but it might just be that you have to go to road tyres.'

Tread carefully

While trends in the road car market are bound to impact on motorsport supply, there are also changes to tyres for reasons of sustainability to think about, too.

'Pure motorsport tyres don't have to meet any regulations for rolling resistance, wet grip, noise etc,' notes Meaker, 'but the tyre manufacturers still have to be seen to be trying to be sustainable. And there are new regulations going through, about abrasion, tyre wear and particles that come off tyres.'

That last point refers to the forthcoming Euro 7 legislation, which, while aimed at road car tyres, is sure to have a knock-on effect in that companies making motorsport rubber will want to be *seen* to be doing 'the right thing'. Meanwhile, tyres that are designed for roadgoing vehicles but are also used in racing will simply have to comply.

This would not be the first time motorsport tyres have changed to keep in step with the wider market.

'We went through a period in the mid-2000s where the compound had to be cleaned up,' recalls Nicholls. 'There was a lot of re-formulation of compounds at that time to take out any potentially dangerous substance, to ensure it was a non-carcinogenic product.'

Another way to tick the sustainability box is by limiting tyres, something a number of series at every level are now doing.

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This is both kinder to the environment, because fewer tyres are manufactured and shipped, and easier on the wallets of competitors. A good example of this is the 750MC's Sports 1000 Championship (see *Racecar* V34N1), where only three sets of Nankang AR1 tyres are allowed per season.

'It's not just environmental sustainability, it's also the sustainability of a championship in terms of trying to keep the budgets at a reasonable level,' says Groombridge. 'So it's something we do in quite a lot of championships now, and is becoming increasingly common. Technology obviously makes it easier for us to police this, with apps and scanners and stuff like that. I can see it becoming more commonplace.'

Naturally, this means tyre makers will sell fewer tyres, but Toyo, for example, isn't too bothered about this.

Party politics

'Yes, we'd like to sell more tyres, but it's got to work for everybody involved,' says Meaker. 'That's also the case when it comes to sponsoring a championship [as a supplier]. There are three parties involved in a sponsorship deal: the tyre manufacturer, the club and the competitor. If it works for all three, it will work. And this does.'

While there are advantages to this, championship organisers must still be careful.

'There really has to be significant checks and balances in safety,' says Dee-Crowne. 'What you don't want is people running around a racetrack on tyres you've restricted them to – let's say, one set every two races – and the tyres have gone off, or are damaged, which then cause a danger.

'You've got to look at sustainability, and all of that, but you have to temper it with the fact it's primarily about safety.

'We already have an answer for that. If you have a control set of tyres, and you're restricted to a certain number, then if you damage a tyre, you can ask the scrutineers to check if it is really damaged. If it is, then you can get a new set approved.'

Slick work

While there are clearly some issues with tyres in European motorsport at the present time, it's interesting to note that most involved are optimistic about the future.

'There's opportunity for us as a business, but there's also the opportunity for other manufacturers to come in,' says Nicholls. 'So, as a customer, as a competitor, you will probably have more choice than ever.'

'I think certainly short to medium term, I'm reasonably optimistic,' says Groombridge. 'Especially with the cars that runs semi-slicks, because if manufacturers like Yokohama and Dunlop start to back away from that market, or only look at 18-19in wheels, there does seem to be people that will fill the gaps.

'At the moment you've got Toyo, and the Chinese manufacturers are seemingly very keen on becoming involved too, as well as people like MRF in India.'

'Our strategy is to flip the motorsport tyre business marketing model on its head by focusing solely on low-volume racing and specialist tyres as the core of our commercial offering'

Paul Hallas, managing director of SPC Rubber Group

And then there's Nova, which has made it clear it intends to fill any vacuum that arises in the national motorsport tyre market with Avon-branded and its own brand products.

'Our strategy is to flip the motorsport tyre business marketing model on its head by focusing solely on low-volume racing and specialist tyres as the core of our commercial offering,' says Hallas. 'We want to focus on those niche areas the larger companies are not really that bothered about.'

This is something Hoosier has done since its inception, so it's fair to conclude that even if the large tyre manufacturers do drift away from club and national motorsport, there's likely to be a specialised supply available to racers. Competition means cost should be kept under control, too. Hopefully, all this means UK paddock chat about tyres this year will be more positive than it was in 2023.

Jonathan Elsey

Cars in the Sports 1000 Championship are limited to three sets of Nankang AR1s per season. This is just one of a number of entry-level series that operate successfully with strict tyre limits

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Chris Green Photography

It is not uncommon to see 50 or 60 cars line up at the start of a TA2 race and the brand rivalry between the likes of Ford, Chevrolet and Dodge is as fierce as ever

All-American

TA2 is the most exciting class in America's Trans Am Series and is proving to be the ideal breeding ground for future NASCAR talent

By DON TAYLOR

In the United States, where V8-powered muscle cars were born in the 1960s, and hang on to this day, the bespoke road racing platform created for them has been the Trans Am Series.

In the beginning, it was home to stars like Parnelli Jones, Mark Donohue and Peter Revson, while later years featured the likes of David Hobbs, Willy T Ribbs and Tommy Kendall. Iconic racing dynasties with Trans Am teams include Penske, Carroll Shelby, Dan Gurney and Jack Roush.

Through decades of highs and lows, it has remained *the* place for V8, bumper-to-bumper, road racing action.

Factory works teams have dominated in various eras, with the longest rivalry being between Ford's Mustang and Chevrolet's Camaro. Their greatest duel takes place on the streets of Detroit on a semi-regular basis, The Motor City 100, held right in front of each company's executives.

Other cars not fitting the formula, such as the 4WD Audis that entered in 1988, which were force fit into the rules at the time, have come and gone, but the V8s have remained.

Latest iteration

It was the SCCA (Sports Car Club of America) that originated the series, and is still involved to this day. Through a 25-year agreement, SCCA Pro Racing sanctions Trans Am events and provides officials working under the direction of the Trans Am rights holders.

Images by author, unless stated

Racers

The Trans Am TA cars may have more power, and more rules freedom, yet it is the TA2 class that has the greater number of entries, and runs a feature race by itself at Trans Am events

Chas Howe is the second generation owner of Howe Racing Enterprises, the largest producer of TA2 racecars

Several groups, often including competitors in the series, have owned the rights to the name and to run the events over the years, and its latest iteration, which began in 2011, is managed by the Parella Motorsports Holdings (PMH) group.

The Trans Am Series has evolved to be the umbrella name for five different classes, which include various Touring and GT cars. But it is the top two categories, TA (or TA1) and TA2, that continue the V8-powered, Detroit muscle car formula of old.

The Trans Am TA cars may have more power, and more rules freedom, yet it is the TA2 class that has the greater number of entries, and runs a feature race by itself at Trans Am events. It is TA2 that gets back to the roots of this beloved series, allowing only throaty, V8-powered Mustangs, Camaros, and Stellantis-Dodge Challengers to engage in short (100-mile), sprint-style shootouts. With starting fields numbering 50-60 cars, the TA2 drivers deserve their own race and, with the cars being so closely matched, they provide tight racing throughout the field.

John Clagett, long-time president and chief executive officer of the Trans Am Race Company, has spent the last decade rebuilding the Trans Am Series to today's record level of success. He describes the series as 'contemporary-bodied racers, 200 miles per hour, no driver aids, no traction control and mano-a-mano style racing… 100-mile sprints, man [and women, too] and machine.

'One of the underlying philosophies of it was to create a series that was obtainable with today's racing budgets on a non-manufacturer level,' he continues. 'Rules stability being a secret to success.'

Tubular steel

So, what exactly makes up one of these TA2 cars, and how are costs controlled?

To begin with, only three chassis manufacturers are approved to build the cars. TA2 class rules specify a tubular steel chassis built either by Howe Racing Enterprises, Mike Cope Racing or M-1 Motorsports.

We spoke with Chas Howe, president of the original and largest producer of these cars, Howe Racing Enterprises of Beaverton, MI.

Though ostensibly a non-contact race series, TA2 cars are built tough

Howe chassis are constantly refined for safety. The driver cell of the company's 2023 TA2 offering is to SCCA GT specs

Engine bays are wide and open, allowing for the easy fit of a V8 motor

The steel spaceframe chassis uses a combination of tube and box section with sturdy aluminium close-out panels

We then visited Howe's biggest TA2 customer, Silver Hare Racing, to learn more.

Howe was just 23 when he took over the business started by his father, Ed Howe. That was 35 years ago. Howe Racing Enterprises' long-time trade had been in short track oval racing and similar variations of tube-framed, sportsman racecars, supplying chassis, components and complete cars. During the 1990s and early 2000s, the company built many of the popular ASA (American Speed Association) Series cars. It was also the largest producer of Asphalt Late Models, a mainstay of American, Saturday night racing.

Howe's move from short-oval, left-turn-only cars for the domestic market to becoming a manufacturer of internationally raced, road racing cars started when, after 15 years of oval track racing, he attended the Winfield Racing School in France in 1989 and had the opportunity to race formula cars.

Back home, as Late Model racecar sales slowed down when oval track, asphalt racing started to become less universally popular, he started thinking internationally.

Meanwhile, in Sweden, race promoters had a vision for a new, affordable V8 racecar after seeing a *Transformers* movie! In that film, a fifth generation (2010) Camaro is introduced as the yellow and black Transformer known as Bumblebee. The promoters thought that would make a great race car for a Camaro Cup series – now called V8 Thunder Cars – so, logically, went to America to see who might be able to bring such a car to life.

Howe Racing Enterprises has sold more than 500 cars to date. Of those, 205 have gone to US customers, while the majority of others have found homes in Australia, Sweden and Mexico

Recommendations led them to Howe who, in turn, used his GM connections to secure an early body-in-white of the then new Camaro, along with a suitable V8 engine. Combining these with his company's proven chassis design, he was able to present a prototype demonstrator. Today, that series runs races in Sweden and Finland with 20-30 Howe cars typically on the grid.

In 2015, Australian race promoters were also looking for a more affordable road racing series platform, and took note of what was by then called the TA2 car, and also contacted Howe. The result of that 'phone call is the TA2 Racing Australia National Series, which hosts nine multi-race weekends per season, plus the ARG series, with nearly identical rules as the American counterparts, and with cars supplied by Howe.

Steady growth

That all neatly brings us back to the US Trans Am series. In 2010, the SCCA was looking to sell off the idle series' rights to an interested driver group. The series had been looking at the SCCA's GT-1 class cars, which had some roots in Howe's ASA circle track car chassis. As the sanctioning body was aware of the affordable Howe cars racing in Sweden, it contacted Howe with the idea of that design becoming the next generation Trans Am car.

The series has steadily grown since.

Altogether, Howe Racing Enterprises has sold more than 500 similar cars to date. Of those, 205 have gone to American customers, while the majority of others have found homes in Australia, Sweden and Mexico.

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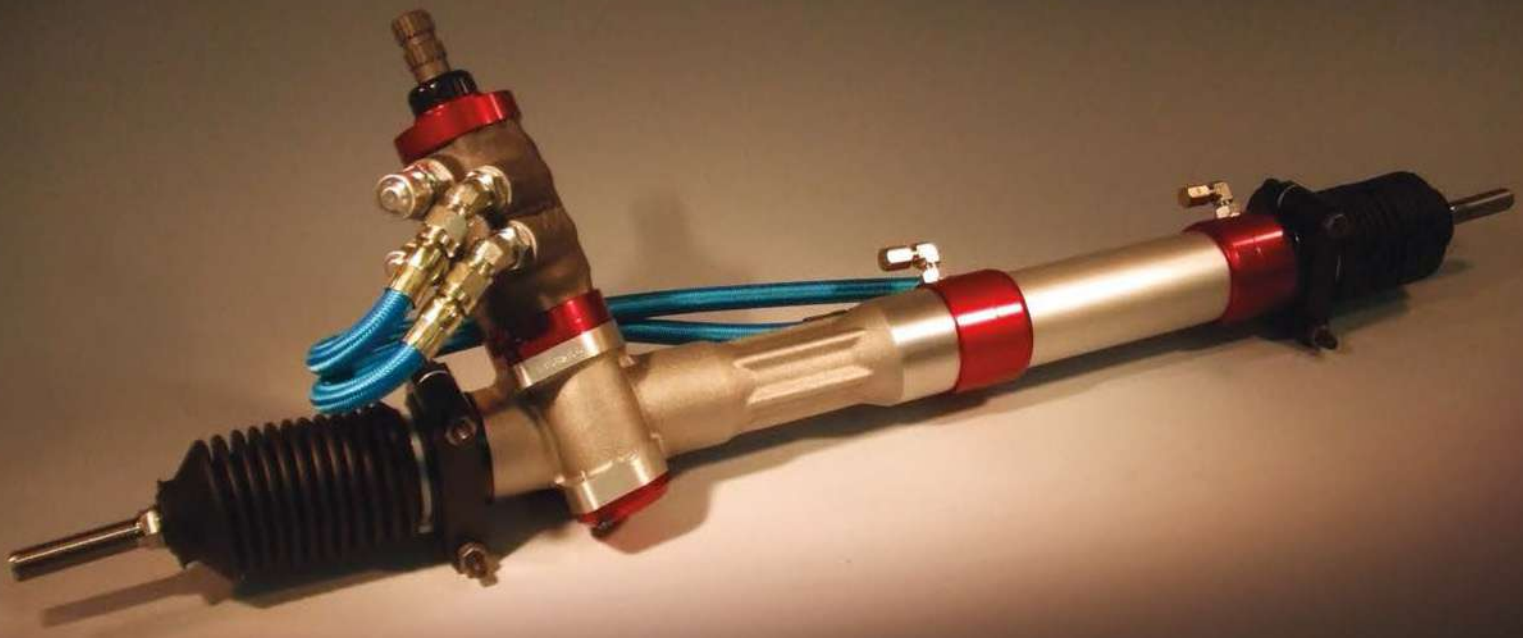

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Jack Shanlin

Connor Zilisch, aged just 17, won five of the 13 TA2 races in 2023 in a Silver Hare Racing Camaro, proving the value of the series as a training ground for potential future NASCAR stars

TECH SPEC: Howe TA2

Chassis
Steel tube welded spaceframe / rollcage

Suspension
Front: double A arms; coilover spring / damper; stabiliser bar

Rear: solid axle; three-point location; Panhard bar or Watt's linkage; coilover spring / damper; stabiliser bar

Steering
Sweet or Woodward rack and pinion; hydraulic power assist

Body
Chevrolet Camaro; Ford Mustang; Dodge Challenger glass fibre silhouette with adjustable spoiler and front splitter; flat underside

Powertrain
Engine: Pushrod, OHV, 6.3-litre V8 making 500-525bhp through air restrictor

Transmission: four-speed manual

Differential: Gleason LSD or Detroit Locker

Dimensions
Wheelbase: 102-105in

Weight: 2830lb minimum, including driver with race gear

While credit for coining the name TA2 may go to others, with the series' roots stretching back to that first car design for the Swedish series, Howe can rightly be considered the father of the TA2 car.

Vehicle design

To better understand what has made the TA2 car, and the formula it supports, so successful, we need to review the Howe vehicle.

The chassis remains a simple, welded steel spaceframe comprising box section rails and round upper tubes, with aluminium and steel close-out panels. The central cockpit complies with SCCA GT rules for tubing size and material, and features side protection bars.

The front structure has a wide bay to accommodate various V8 engines, and uses bolt-in braces to stiffen it up.

The front clip includes suspension pick-up points and a sturdy cross tube for the low-mounted stabiliser (anti-roll) bar, in a position to protect the steering rack behind it.

It also has short tubes at the sides in which to slide an easily replaced auxiliary structure that supports the radiator, the body's nose and front splitter.

The front suspension is conventional with double A arms, lower arm-mounted coilover dampers and the aforementioned stabiliser bar. Stacked shims on the upper arm mount allow for quick camber adjustment, and the 2023 version of the chassis has optional adjustable front shock mounts that allows teams to experiment with ride heights without changing the spring load.

Teams are not allowed to modify pick-up points, components or the chassis structure.

Howe fits Penske dampers and Hyperco springs as standard, with its own design of shock an option, or the customer may provide their own. Either way, the Trans Am Series puts a US$925 (approx. £732) maximum cost limit per item.

A Sweet Manufacturing hydraulic power rack and pinion steering unit is standard, while a Woodward version is optional. The speed of operation and 'feel' may be tailored to driver preference with either one.

Suspension is conventional double A-arm and coilovers

The Howe TA2 cockpit is all business, right down to the H-gate shifter and very deliberate lack of driver aids

Hydraulic power assist rack and pinion steering is as much aid as drivers are given. Supplier is either Sweet Manufacturing or Woodward Steering

Behind the cost-controlled disc brakes are Howe fabricated uprights, based on a design pioneered by Chas Howe's father, Ed, in the 1980s

It should be noted that no titanium or glass fibre components are allowed, except for in the driver's seat and rear wing

The upright is a Howe-produced part, fabricated from steel tubing with a two-inch ID bearing. This, incidentally, is an oval track standard originated by Ed Howe in 1986.

Standard is a crossflow, aluminium radiator, produced to Howe's specifications, which includes a surge tank. Most cars used an air-to-oil cooler in the duct, but others have a heat exchanger in the radiator tank. There are also additional coolers for the power steering, transmission and rear end.

Suspension and brakes

The rear clip is a simple structure, designed to accommodate the suspension, rear wing loads and the fuel cell. Rear suspension consists of a solid axle, located by a three-link configuration with two adjustable height trailing arms, and a choice of a very 'non-linear' (bent to avoid the driveshaft) Panhard bar or Watt's linkage for lateral location.

The latter is mounted on a Tiger Quick Change rear end, which has an integral cooling pump and cooler. A Gleason differential is standard, with an Eaton Detroit Locker optional. Though hugely popular, Ford nine-inch rear ends are not allowed in TA2, as the quick change is ultimately considered less expensive in the long run.

As with dampers, the cost of brake calipers, brake pads and wheels are also controlled. This allows some choice for competitors, and some opportunity for different component suppliers, but it does require monitoring by officials. Parts must be available at the same price to all racers.

Howe customers can choose from four approved brands of brake calipers: Alcon, Brembo, Pro Systems or Wilwood. The cost limit is US$650 (approx. £515) front and $550 (approx. £435) rear, per axle.

The front brakes have cooling ducts to the discs with fans optional. Brake discs have a cost limit of $250 (approx. £200) front and $275 (approx. £220) rear, per disc. Brake pads are limited to $300 (approx. £240) per axle.

It should be noted that no titanium or carbon fibre components are allowed, except for in the driver's seat and rear wing.

Pirelli is the sole tyre supplier of the TA2 class and the title sponsor of Trans Am, providing its P Zero DTA 275/695-15 as the series spec rubber. It is available in only one compound, with an alternative patterned rain version also in use. List price per set is US$1280 (approx. £1014).

With low miles on race weekends, and no planned pit stops, most teams can make their tyres last a long time.

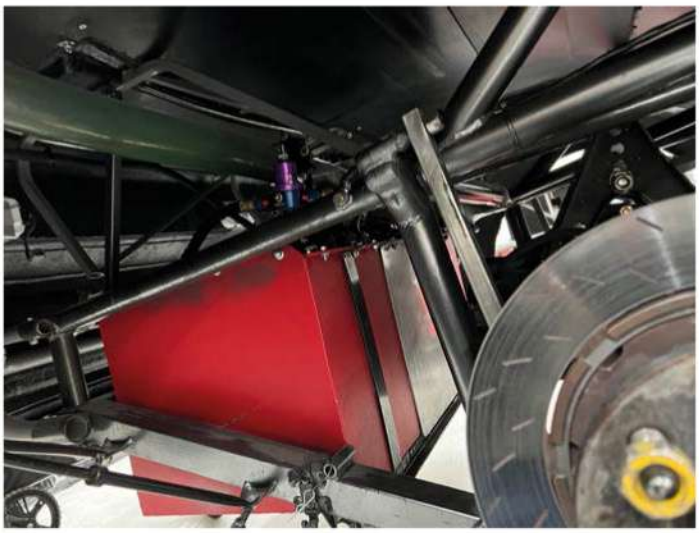
In another move to control costs the Pirellis are wrapped around the durable, five-lug, D-slot, 15 x 10in stamped steel centre wheels that have served decades of NASCAR competitors well. Manufactured by Bassett or Aero, they weigh 21lb (9.5kg) each and cost a maximum of US$155 (approx. £125) per wheel. Painted or chromed, they look like they're there for business.

The standard fuel cell in a Howe car is a 26-gallon Pyrotect with a surge tank and one pump. Fuel options include a pump-out port and a three-pump lift system.

In one of TA2's 100-mile sprint events, a car consumes between 22 and 24 gallons.

Silhouette body

The Chevrolet Camaro (gens five and six), Ford Mustang (gens five and six) or Dodge Challenger (gen three) bodies are today all built by Five Star Racing Race Car Bodies.



Tubular rear clip provides location points for the suspension, rear wing and 26-gallon fuel cell

Solid axle rear suspension with quickchange is located by a three-link system and Watt's linkage

Manufacture is by way of a vacuum-bagged glass fibre process, with an optional polypropylene lower front fascia.

The body package comprises 14 separate panels for low-cost replacement, plus a windscreen, quarter windows and back glass. Current list price is US$10,850 (approx. £8594).

The cars deliberately look quite close to stock from the outside, just hunkered down over the wheels. Adding to that image is a required use of the production cars' outside rear view mirrors, though that requirement has now been dropped in the US series.

Since the production-size doors don't open in the glass fibre bodies, there is provision for a mini-door cut into the driver's side (LHD) to help driver access. It can be mounted to either fold down or open conventionally, a feature that has proved helpful for drivers in the series who may no longer be maintaining a weight they once did.

All bodies must remain unaltered from their production shape. No heating and warping of surfaces, no use of body filler to sharpen edges, no taping of joint lines, no recessing the back glass, or any other such aero tweaks area allowed.

Add-on rear spoilers, Gurney flaps, vortex generators and front dive planes are also banned, and the underbody must be kept flat. There is a bit of flexibility in the front fascia for the radiator and brake cooling duct cut-outs, and an allowance to cut 200in^2 of air exit louvres in the hood.

The job of downforce and balance tuning is left to the front splitter and adjustable rear wing. The single-element, single-source 'Derhaag Rear Wing' (named after long-time Trans Am competitor and supplier of the wing, Jim Derhaag) is standard for all cars. Its angle is adjustable, with no defined angle limits, but the height cannot exceed the roof on the Camaro and Challenger, and must be half an inch below the roof on the Mustang.

V8 powertrain

As with the chassis builders, approved engine suppliers are also dictated by the rulebook. Power units are all modified production, naturally aspirated, pushrod V8s, which are prepared and sealed with measured power outputs of 500-525bhp, limited by an intake restrictor.

Packages for each brand's approved engine include specific factory heads, blocks and induction, with approved camshaft, crank, pistons and rods.

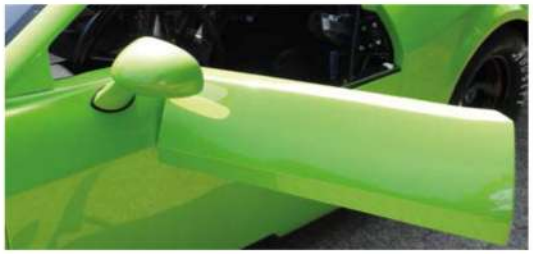
The engines are fed by factory EFI, with electronic engine control by AEM or MoTeC. Curiously, given the way NASCAR has gone, Trans Am included a carburettor option in 2023, which can favour certain tracks. This has added cost, though, as racers need to buy one or suffer a disadvantage at some circuits.

Only three body styles are allowed in TA2. Competitors must choose from a glass fibre replica of a Ford Mustang (shown above)…

…a Chevrolet Camaro (shown above) or a Stellantis-Dodge Challenger. Each body package comprises 14 panels for ease of repair

Aerodynamic aids are strictly limited and the body must retain its factory profiles. A front splitter and flat underside are mandatory

To ease entry and exit, a mini-door is allowed on the driver's side



Customers choose whether the door opens conventionally or drops down

Power units are all modified production, naturally aspirated, pushrod V8s, which are prepared and sealed with measured power outputs of 500-525bhp, limited by an intake restrictor

Competitors almost all now use the GM LS3 engine, regardless of exterior body style

Pushrod-operated V8s use electronic fuel injection, though a carburettor is optional for certain tracks

There are five approved engine builders, but 90 per cent of the powerplants come from Katech Engineering or Pro Motor Engines (PME). The only remaining Ford and Chrysler Hemi engines are in older cars running in the west coast series; everyone else now runs Chevy LS3 engines, most migrating to what they call the 'Choice Spec' engine package, which was defined during the pandemic to further control costs.

These engines can be good for a whole season between rebuilds and cost US$35,000 – $40,000 (approx. £27,720 – £31,680) to buy. To that, add headers with a cost limit of $1950 (approx. £1550) or a complete exhaust assembly at $2300 (approx. £1820) max.

The exhaust crosses over at the rear of the engine and exits below the right-side door, or even further forward.

Transmissions in the class go back to basics (and the cars' muscle car roots) which means a manually shifted, H-pattern, four-speed 'box and a strong right arm. The choices from Howe are the G-Force G101A, which is more affordable, or the Andrews A431. The latter are refurbished units, off lease from NASCAR.

All American TA2 cars are fitted with a Quartermaster or Tilton clutch with an aluminium bellhousing and reverse starter.

Put all the pieces together, add a few pounds of ballast, and the package should come to the minimum weight (including driver and any driver gear) of 2830lb (1284kg) required for all cars in the series.

With no *Haynes Repair Manual* for TA2 cars available, Howe provides the next best thing to customers in its own 75-page owners' manual. The book covers set-up and adjustment options, as well as maintenance, torque specs, recommended spare parts and required tools. It contains everything a racer needs to get started.

'If the rules remain stable, used cars stay competitive, and the second half of your class will buy from the first half at a lower price point, doubling the number in the class'

Chas Howe, CEO at Howe Racing Enterprises

Roller coster

A 'roller' from Howe consists of a chassis, insulated interior, body, suspension, steering, brakes, brake lines, wiring, fuel cell and fire system. Without dampers, drivetrain, seat or electronics, that currently lists at US$92,000 (approx. £72,850). Adding in the engine, ECU, exhaust, driveshaft and seat required brings the total for a TA2 car to just under $175,000 (approx. £138,575).

It's not quite race ready at that point, but it's still a pretty attractive price compared to the more exotic GT class offerings out there.

'Cost creep is always a problem in racing because technology never costs less,' says Howe, a long-time advocate of cost containment. 'Racers are therefore compelled to buy whatever equipment is required, or will give them an advantage, so the rulebook determines everything.

'You will only have a high value car if every rule favours the high value components.

'If the rules remain stable, used cars stay competitive, and the second half of your class will buy from the first half at a lower price point, doubling the number in the class.

'This doesn't happen when constant rule changes and unregulated technology make older cars obsolete.'

Customer viewpoint

To take a look at a Howe TA2 car in user hands, we visited Maurice and Laura Hull's Silver Hare Racing, based in High Point, North Carolina. As Howe's biggest customer, the team can field as many as six TA2 cars for in-house drivers and for arrive-and-drive customers. It's an impressive operation, with a win record to go with it.

Crew chief and manager, Jeff Holley, shared what it takes to run a TA2 car.

With so many limitations on modifying the hardware, he focuses instead on thorough preparation and reliability. Data acquisition is allowed on the test day preceding most TA events, which he takes advantage of, but it is not allowed once official practice begins, and through the race weekend.

Holley says he prefers to be ready to race when arriving at the track and finds the cars straightforward to set up. That's important when you are showing up with so many cars, and drivers wanting to win.

Having a long-term relationship with Howe, both as a customer and a parts distributor, has, says Holley, been a positive experience for Silver Hare: 'They welcomed Silver Hare Racing in, and myself, years ago and have been nothing but first class. If you want to race cars that run up front and are built in the USA, then Howe is the only way.'

While many veteran road racers have been running in TA2 for the fun of it, the TA2 series has also become a place for drivers already in various NASCAR classes to hone their road racing competency, as well as for new talent to develop their skills on the way to a NASCAR career.

NASCAR pathway

The Trans Am Series has no interest in manufacturers like Ford and Chevrolet fielding factory teams and creating an arms race, but they do welcome being a driver development tool for them.

'We're not anti-manufacturer,' emphasises Clagett, 'but what we'd love is for the manufacturers to support drivers, with driver contracts and a marketing platform, whether it's in the city or at the event. That's where we really see what the manufacturer partnership is all about.'

One such driver is Connor Zilisch who, at just 17-years old, won five of the 13 TA2 races in 2023 as a Silver Hare team driver. He followed that up by being one of the standout drivers in the class-winning LMP2 car at this year's Daytona 24 Hours.

With Chevrolet support, Zilisch is signed on this year with Trackhouse Racing, a group that will allow him to race in the ARCA and Xfinity stock car series, among others, all paving the way for a NASCAR Cup seat.

He is not the only young driver talent coming up in TA2 either, as Clagett notes: 'In 2023, we had 26 drivers taking part in the TA2 Young Gun competition, meaning they were 25 years or younger, and 39 rookies overall in the category.'

That alone shows how much influx of young talent the series has.

'It's exciting to see that Trans Am has returned to its place as the development series,' adds Clagett. 'NASCAR owners, drivers and team crew are now starting to recognise the value of spending time in our series to hone their skill set.'

All change at the top

As the Trans Am TA2 Series rolls into 2024 (the season kicked off at Sebring on 22-25 February), the cars remain the same but big changes have been made in the Trans Am organisational structure. The series parent, Parella Motorsports Holdings (PMH), has been acquired by private equity firm, Velocity Capital Management, with PMH company founder, Tony Parella, continuing as chief executive officer.

Meanwhile, Trans Am has new leadership under PMH COO, Mark Printup. Clagett has now stepped down after completing his mission of reviving the classic series and bringing it to a new high.

Trans Am also features a new title sponsor this year, and is now known as the CUBE 3 Architecture TA2 Series.

All of those changes will bring the potential for adding more high-profile races, more media attention, a stable TV package and even more entries on the grid.

As for Howe, he says his company 'remains committed to the series, and will make every effort to assist the new management in succeeding.' To do that, he will remain focused on providing safe, affordable cars for his customers while, at the same time, 'feeling blessed to have been able to work with my parents and now work with my wife and adult children.'

What is exciting, in a world filled with AI, autonomous vehicles, hybrids and fuel cells, is that the simple, affordable V8 muscle car continues to appeal, to young and old alike, thanks to people like Chas Howe. He, no doubt, will continue to fight the 'cost creep' battle to keep the series as popular and competitive as it has become.

Safety simulation

Throughout his career, Chas Howe of racecar constructor, Howe Racing Enterprises, has taken the initiative in the interest of his customers to continually improve the safety of his cars.

In 2000, he worked with GM Racing's safety programme on the development of an ASA 'Safety Demonstrator Car.' That work was carried out with GM's Tom Gideon, who went on to be the safety director at NASCAR's R&D Center.

'When we introduced this car, our previous experience came from oval track cars such as ASA,' notes Howe. 'Road racing is more demanding of the car in nearly every way. Oval accidents are more frequent, but road racing accidents tend to be more severe.

'In oval track racing, the difference in speed from straight to corner is small enough to stay in one gear, and the walls provide glancing angles, but in road racing, you may go from 170mph down to 50 and downshift three times. If your brakes fail, it is like falling from the sky and losing your parachute.

'We have changed materials, design and welding processes to improve the chassis, but the most significant safety gains come from preventing the causes. So, we beefed up the brakes, steering and suspension and emphasised maintenance.

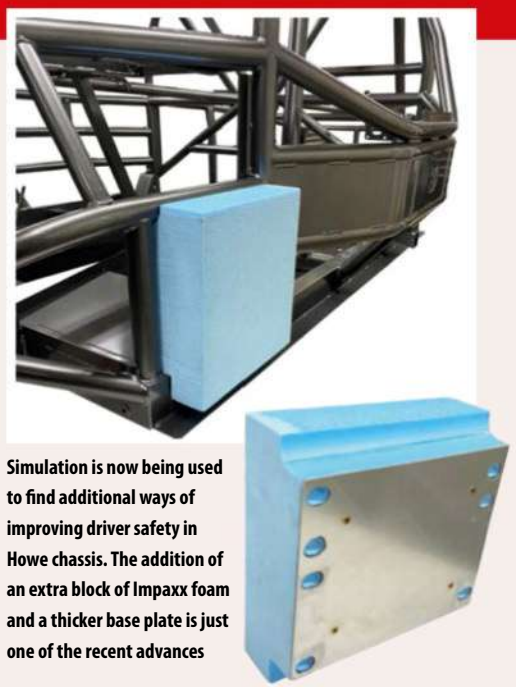
'You must be careful not to overreact to one type of accident and trade risk for another,' Howe continues.

An example of an incremental improvement was shown at December's PRI Show in Indianapolis. After a crash by a competitor's car at the Atlanta TA2 race last year, the Howe team thought of ways to increase protection on the driver's side, and turned to simulation to model it.

Chas' son, Charlie, initiated a computer simulation of the side impact on their chassis and reported, 'This simulation is far beyond any real-world accident we have seen. However, this data established a baseline for the potential failure points and energy transmitted to the driver.'

After several iterations, Howe junior found 'a practical improvement for one type of accident that is lightweight and low cost. The simulations showed that adding a well supported, four-inch thick Impaxx foam block to the foot box, along with a thicker base plate and support bar, reduces chassis damage and energy transition to the driver.'

Needless to say, this practical safety enhancement will be added to all new Howe cars built, and offered for retro-fitting into existing cars.



Simulation is now being used to find additional ways of improving driver safety in Howe chassis. The addition of an extra block of Impaxx foam and a thicker base plate is just one of the recent advances

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The Cat's whiskers

How Jaguar dominated Le Mans in the 1950s, and brought disc brakes into the world of motorsport

By WOUTER MELISSEN

On 24 June 1951, Peter Walker and Peter Whitehead scored a historic debut victory with the Jaguar C-Type in the 24 Hours of Le Mans. Designed as a competition car from the outset, the C-Type ushered in a new era at Le Mans of purpose-built racecars that continues to this day.

The brand new Jaguar had been developed in great secrecy by a talented team of engineers lead by William 'Bill' Heynes. After a disastrous outing in 1952, the C-Type would win Le Mans again, and also went on to pioneer the use of hydraulic disc brakes in motor racing.

The Le Mans-winning Jaguar was officially known as the XK120 C, with the C being short for Competition. By using this name, the British manufacturer suggested a direct link between the recently introduced XK120 production road car and the new sports racer. This was obviously a smart marketing ploy, but was also intended to placate the Le Mans organisers, who stressed that all the cars competing at Le Mans had regular production counterparts.

What the two cars definitely did share was the 'XK' straight-six engine. It was created on the insistence of Heynes, who convinced company founder and president, William Lyons, that Jaguar needed an engine of its own design and making.

Development reportedly started during the war, when Heynes discussed designs with Walter Hassan, Claude Bailly and Harry Weslake during fire watch turns on the roof of the factory. A range of four and six-cylinder engines were built and tested until the team settled on the 3.4-litre XK six.

The XK engine

Jaguar's first proprietary engine was built on a cast iron cylinder block. The crankshaft ran on seven bearings and featured an innovative Metalastik vibration damper on the front to eliminate resonances.

A lightweight, aluminium alloy cylinder head was used, which featured twin overhead camshafts. These were driven from the crankshaft by a chain at the front of the engine. The valvetrain was unusual in that the inlet valves had a 30-degree angle, while the exhaust valves were mounted at 45 degrees.

Designed as a competition car from the outset, the C-Type ushered in a new era at Le Mans of purpose-built racecars that continues to this day

Breathing through a pair of SU carburettors, the first iteration of the XK engine produced 160bhp.

To showcase the new engine, Lyons had a compact sports car built, using a shortened chassis from a late Mark V saloon. This was a box section steel frame with double wishbones and torsion bars at the front.

The rear suspension consisted of a live axle and semi-elliptic leaf springs, while a four-speed, all-synchromesh gearbox with a single plate Borg & Beck clutch was used.

The rolling chassis was clothed in a flowing aluminium body, which was a further development of the pre-War SS 90 and 100 sportscars.

Launched at the 1948 London Motor Show, the new Jaguar was dubbed the XK120, which was a reference to both the engine designation and the car's claimed top speed. That claim, incidentally, was underlined by a number of high-speed runs conducted on a stretch of Belgian highway near Jabbeke. With a full windscreen fitted, the swoopy Jaguar clocked 126.6mph.

Limited run

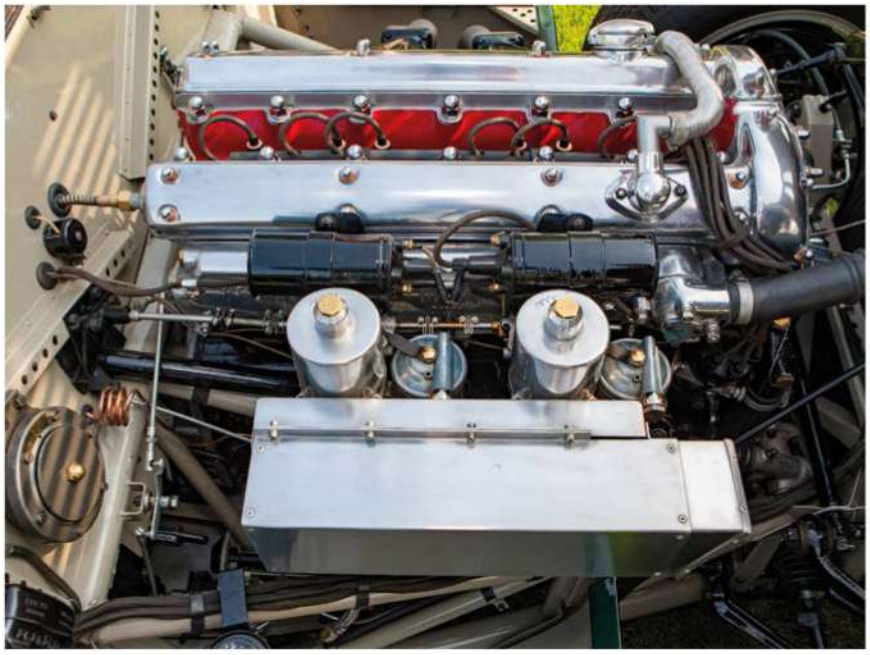
While the two-seater roadster had been developed predominantly to showcase the new engine, Lyons did entertain the thought of a limited production run of 200 examples, which he felt would be well received. The car was, and customer versions soon followed.

After the initial 242 cars were built, the handmade aluminium bodies were replaced by more economically friendly steel coachwork.

The British manufacturer went on to build 12,055 examples of the XK120, in its various guises, between 1948 and 1954.

The XK120 was not part of a Jaguar works competition programme, but XK120s were raced by privateers, including Stirling Moss, who was victorious in the 1950 Tourist Trophy,

The XK series of cars were designed around the company's new engine: an iron block, 3.4-litre, DOHC, straight six



Early production versions, and some of the first race engines, used a pair of SU carburettors and made 160bhp

A long-tail version of the car with a smaller front grille was built for the 1952 Le Mans race but overheating issues forced all three works Jags to retire

For the 1954 season, the C-Type was replaced by the D-Type (behind). With its revolutionary monocoque construction, it continued Jaguar's formidable racing form in the 1950s

The ultimate incarnation of the 3.4-litre XK engine came in 1953. It had a higher compression ratio and wore triple Weber carburettors for 220bhp, a significant power output in an aluminium-bodied racer that weighed just 880kg

Chassis is of twin tube construction with lateral crossmembers attached to the lower rail and the double wishbone front suspension and bulkheads fixed to the top rail. Additional longitudinal channel sections added extra rigidity

and Johnny Claes who won the gruelling Marathon de la Route rally from Liège to Rome and then back to Liège. Crucially, Nick Haines and Peter CT Clark finished an impressive 12th overall at Le Mans in 1950, with only a mildly modified XK120.

Buoyed by the XK120's competition success during the 1950 season, Lyons and Heynes hatched a plan to score an overall victory in the French 24-hour classic. Winning that prestigious endurance race was expected to do wonders for Jaguar sales at home and, more importantly, in the lucrative North American market.

While the XK120 had proved itself by finishing in the top 12, it was 26 laps down on the winner, which was a gap impossible to bridge by further developing the existing car. Instead, Lyons tasked Heynes with the construction of a lighter, more aerodynamically efficient competition car that would use the XK engine.

Heynes laid down his interpretation of a tubular frame. The bottom half was formed by two longitudinal tubes and four crossmembers. Additional tubular sections formed the top half of the chassis with crossmembers to support the front suspension mounts and dashboard and to form the scuttle and rear bulkhead.

To this mass of tubes, Heynes added a channel-section frame to impart some rigidity to the car's floor. These sections were cross drilled to reduce their weight.

As on the production XK120, the C-Type front suspension consisted of double wishbones with longitudinal torsion springs that were mounted low in the chassis on both sides of the engine.

Behind the rear bulkhead was a live rear axle, which also used torsion bar springs.

Hydraulic dampers were fitted on all four corners, as were hydraulic drum brakes.

Mounted on top of the rear suspension was a massive fuel tank that could hold at least 40 imperial gallons of petrol.

The C-Type was clothed in an even more slippery, hand-beaten aluminium body that bore only a passing resemblance to the XK120. The most obvious were the oval radiator grille and the waistline.

Increased power

Powering the C-Type was a further development of the XK engine. In its 1951 configuration, the engine still boasted a pair of SU carburettors but, thanks to a compression ratio raised to 9:1, the 3.4-litre competition engine produced an additional 50bhp, up to 210bhp.

By 1953, with triple Webers fitted, this was upped further still to 220bhp.

As on the XK120, a four-speed gearbox was fitted with synchromesh rings on all forward gears. The final drive ratio could be changed to suit the needs of each circuit.

As raced at Le Mans in 1951, the C-Type weighed 940kg, which represented a weight saving of well over 300kg compared to the aluminium-bodied XK120 production car.

Unbeknown to its rivals, Jaguar had managed to prepare a full team of three XK120 Cs, or C-Types, for the 1951 edition of the 24 Hours of Le Mans. Among the main competitors were production-based Aston Martins, an assortment of Ferraris and the V8-engined American Cunninghams. These were also purpose-built racecars and, in order for the Chrysler Hemi-powered machines to compete, the Le Mans organisers had forced Briggs Cunningham to build and sell a road car version as well.

At that time, the grid was set on the basis of displacement, with the largest engined cars lining up at the head of the field. The cars were then numbered accordingly, with the first C-Type, shared by Peter Walker and Peter Whitehead, given the number 20. Jackman Fairman and Stirling Moss were right behind in number 22, while C-Type number 23 was fielded for Leslie Johnson and Clemente Biondetti. A fourth Jaguar, the XK120 of Robert Lawrie and Ivan Waller, was allocated number 21. All four competed in the Sports 5.0-litre category.

Such was the advantage of having Moss behind the wheel that, by the end of the first lap, the young Englishman had moved up to second place in the C-Type. Ahead of him was only the 4.5-litre Talbot Lago piloted by Formula 1 ace, José Froilán González, who had started seventh.

Sadly, the relentless pace saw two of the C-Types retire with lubrication issues. A slightly more conservative approach saw the Whitehead and Walker Jaguar score the coveted victory with a nine-lap advantage. The sole XK120 entered finished a commendable 11th overall.

Back at the Jaguar factory, the issues that dogged two of three cars were traced to a copper oil pipe that fractured in the sump.

As raced at Le Mans in 1951, the C-Type weighed 940kg, which represented a weight saving of well over 300kg compared to the aluminium-bodied XK120 production car

These were replaced by more robust steel lines, which fixed the problem.

The three updated C-Types were pressed back into service for the Tourist Trophy at Dundrod, where Moss led Walker home to score a one-two result. Moss also won twice at Goodwood a fortnight later.

Great expectations

The C-Type's remarkable debut season sparked the interest of privateer racing teams. Jaguar was keen to supply the new sports racer to third parties, albeit with some restrictions. To ensure the C-Type lived up to expectations, Lyons tried to engineer a situation where only the most talented drivers were allowed to get their hands on one. Juan Manuel Fangio bought one but never raced it and Dr Giuseppe Farina also acquired a C-Type, but that one was sent straight to the Ferrari factory to figure out why it was so fast.

An example of Jaguar being careful in selecting its C-Type racers was chronicled in the March 1973 issue of *Road & Track* magazine. It describes the history of chassis XKC 015, which was one of quite a few C-Types earmarked for the United States. It was acquired new by a young Masten Gregory, under the condition that he let a more experienced racing driver compete with it. A future grand prix driver of course, Gregory was more than capable of racing the C-Type, and showed that by beating his own Jaguar with an Allard at the first outing. Soon after, he was behind the wheel and winning SCCA races in the C-Type.

In addition to the strict selection criteria, C-Type production was hampered by a move of the Jaguar factory and limited availability of high-grade materials just after the war.

Dunlop and Jaguar worked together to develop the revolutionary disc brakes the C-Type was equipped with in 1952, developing technology originally designed to slow down fighter aircraft more effectively after landing

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Mechanically, the production C-Types were similar to the 1951 works cars, but some were subject to minor upgrades over time as development continued.

The production run continued well into 1953, by which time 53 examples had been built, including those raced by the factory.

First evolution

Keen to defend the Le Mans crown, Heynes produced a first evolution of the C-Type for the 1952 race. The threat of a Mercedes-Benz works effort, and a new Aston Martin, prompted the Jaguar engineers to push the performance envelope.

To improve the top speed on the long straights at Le Mans, the bodywork was revised. A deeper nose with a smaller grille was fitted, while the tail was elongated. It was very much a last-minute job, and the updates were not sufficiently tested prior to the event. The result was utter disaster as all three factory C-Types retired early in the race with overheating issues, leaving Mercedes-Benz to take the title that year.

Back at the factory, the culprit was discovered to be the new, smaller diameter cooling lines fitted. These were replaced, but the low-drag bodywork was also set aside.

Development for 1953 focused instead on reducing weight. Thanks to a thinner gauge body, a rubber aircraft fuel bladder and other optimised components, the 1953-specification C-Type was a further 60kg lighter than the original.

These lightweight C-Types were also fitted with the revised intake system that now boasted three twin-choke Weber carburettors, while a Borg & Beck triple-plate clutch replaced the dry, single-plate unit previously installed.

An upper link was also added to the rear axle to improve the car's handling.

Golden discs

The most significant development, however, had been installed for the first time at the start of the 1952 season: disc brakes. Although first patented in 1902, development of modern disc brakes did not really gain momentum until World War II. Dunlop experimented with the system initially to slow warplanes down more effectively after landing. It wasn't until after the war that the system was further developed for use on motor vehicles.

Late in 1951, Dunlop and Jaguar started working together and the first C-Type was fitted with disc brakes early in 1952. The Dunlop system comprised a solid disc with a hydraulically-actuated, three-piston caliper. Less susceptible to brake fade than drums, discs also provided greatly improved stopping power.

Stirling Moss was particularly keen to race with the new disc brakes, and history was made at the 1952 Goodwood Handicap Easter Meeting. Although he finished fourth, he recorded the fastest lap at the event. Moss raced a similarly equipped C-Type at the Mille Miglia that year, but was forced to retire while running third.

Disc brakes were not used at that year's disastrous Le Mans effort, but at Reims later that same month Moss was back at it. Averaging close to 100mph over the duration of the race, he won and scored motor racing's first ever victory with disc brakes.

Needless to say, the 1953 Le Mans cars were fitted with the new disc brakes and, despite ever stronger opposition from the likes of Ferrari, Cunningham and Aston Martin, the lightweight C-Types dominated. Tony Rolt and Duncan Hamilton won handsomely, ahead of Moss and Walker. At 105.85mph, the winning average speed exceeded 100mph for the first time.

From C to D

For the 1954 season, the C-Type was superseded by the all-new D-Type. Still powered by the same XK engine, the new Jaguar featured a groundbreaking monocoque chassis. With a further three outright victories scored with the D-Type, Jaguar became the most successful manufacturer at Le Mans during the 1950s.

Setting the mould for the purpose-built sports prototype, and pioneering disc brakes, the importance to motorsport of the Jaguar C-Type cannot be underestimated. It also established Jaguar as a high-end sportscar manufacturer, a reputation the British company relies on to this day.

Many surviving C-Types continue to see action in historics and, proving their worth, one of the three 1953 lightweights - not even the actual Le Mans winner - sold at auction for a startling US$13.2 million in 2015.

The products of the Browns Lane, Coventry factory, were groundbreaking in many respects, bringing new technology

Thanks to a thinner gauge body, a rubber aircraft fuel bladder and other optimised components, the 1953-specification C-Type was a further 60kg lighter than the original

Despite only 53 examples built, C-Types are still in regular use in historic motorsport today... and still feared by other racers

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Tools of the trade

How a successful GT outfit turned its hand to producing pit and driver equipment that will give any race team a competitive advantage

Manthey's wheel measuring system offers race engineers an easy, accurate way of assessing all regular car set-up parameters

Mention the name Manthey Racing and you immediately think of the successful race team. That's hardly surprising as this year Manthey is already celebrating victory at the Bathurst 12 Hour and will compete in the FIA World Endurance Championship, while also defending its DTM title won in 2023 with driver Thomas Preining.

However, alongside its prestigious racing ventures, behind the scenes the company has developed a range of products it uses at race circuits to give it the competitive advantage, and has made the products available for sale.

Each item has been carefully thought through and designed to the highest specification, making them an attractive proposition to teams racing in prototypes and GTs, as well as road car applications, too.

Manthey Racing was formed in 1996 by former driver, Olaf Manthey, and has competed at international level since then. Now managed by brothers Nicolas and Martin Raeder, the team is firmly established in German and international motorsport.

Manthey's television case is a combined toolbox, work station and TV package, complete with four 16in and two 32in screens, six 230V sockets, secure storage and sturdy wheels so it can easily be moved around the pit garage or workshop

Far from being unique to GT racing, the equipment is also suitable for prototype competition… and appropriate for use in single-seater motorsport

Since 2013, Manthey Racing has been responsible for running GT works entries for Porsche Motorsport at the 24 Hours of Le Mans, as well as providing engineering support to other customer outfits in various series.

Fast and efficient teamwork in the pits is the cornerstone of these performance balanced GT classes. That means teams need to look at all aspects of performance not governed by the rules, and that points towards slick pit work.

Putting that experience into practice, the team has developed its own pit equipment that gives it a competitive boost at the track. Far from being unique to GT racing, the equipment is also suitable for prototype competition, including LMP2 and LMP3, and appropriate for use in single-seater motorsport, so extremely versatile.

Manthey Racing soon established what it needed to be competitive, but couldn't find anything suitable to match its specifications.

Therefore, the company decided to make its own equipment, and it was quickly noticed by other teams who came on board as customers. Manthey soon realised there was a market for its engineering expertise and so continued to produce the equipment for all racing teams, while also diversifying into automotive applications.

Key among the developments is a wheel measuring system that allows for high accuracy when setting up the car in the garage prior to any session. The package is compact but has everything a race engineer needs to prepare the car, including a levelling laser, camber gauge, universal steering wheel gauge, track width gauge and a display for load scales.

All of this comes with a sturdy flight case that allows for safe transport around the world.

For a series such as the DTM, which has only a short time between sessions due to a compact two-day race format, fast and accurate measurement of the car is critical to success.

Oven ready

Alongside the wheel measurement system there is a tyre heating oven that also comes in a flight case. In the basic version of the system, three sets of tyres with different heating programmes can be prepared at the same time. The system can also be expanded to include a fourth chamber if required.

It has a central heating duct, thermo-shielded canvas, touchscreen control unit and can be assembled without the need for tools.

For series where tyre warming is still allowed, the Manthey tyre heating oven is the perfect solution. Available in three or four-chamber configurations, each one can be individually controlled

Manthey's all-aluminium skates are designed to work around a car's on-board air jack system for safe, easy movement in pit lane and garages

One of the necessary pieces of equipment used in today's pit is the television screen, and Manthey Racing has developed a television case that is equipped with four 16in and two 32in screens. The package also comes with two tool trolleys and a large storage compartment, as well as six 230V sockets and two large, lockable storage spaces on the illuminated work surface.

A 10m retractable power cable on both sides can connect to additional power, and the TVs can be connected to the track television feed.

With a sim card, the WLAN is switched online and has a server with 2TB of storage, which is mirrored for data back up. Up to three devices can be connected using the integrated switch and other networks accessed via VPN.

Coolant service

Manthey has also created a handy, portable coolant service unit that can be used for both street and racecars. It allows vacuum bleeding and filling of coolant in accordance with manufacturer specifications, as well as flushing and emptying of the system. Suitable connection packages are already available for various Porsche models, with more to follow.

The system has a large capacity, 32-litre fill and drain tank, and features an integrated separator tank for purging. There are dry-break couplings for hoses and the system comes with a 230V power supply via a five metre integrated, retractable cable.

The maximum pump capacity is 3.5bar, that pumps 12 litres per minute.

Getting a car in and out of the garage quickly is key in endurance racing and, since 2018, Manthey has been producing a skate that fits around the lifting devices of a car, allowing it to be rotated easily. The space saving car skates allow secure shunting of vehicles equipped with an air jacking system and increase workspace safety when fitted.

Load capacity is 840kg per skate.

Having achieved success on track as a racing outfit, now other teams can benefit from Manthey's many years of experience

Plug 'n' play pump

Also critical to overall performance of a team is the driver, and keeping them hydrated is crucial, especially in hot conditions. To aid this, Manthey created a lightweight drinking system that includes a safety lock, bottle, mount, electrical connections, pump and hose connectors and connectors to the helmet.

A plug and play package includes a push button pump activation on the steering wheel. The pump sits in a holder that mounts to the rollcage and features a quick-change system.

The complete empty weight of the system is 856g and the bottle holds one litre of fluid. There is also a cleaning set that helps prevent the system from clogging up.

All these parts are available to buy from Manthey direct at sales@manthey-racing.de or by 'phone. More products and custom solutions are available on request.

Having achieved success on track as a racing outfit, now other teams can benefit from Manthey's many years of experience.

The coolant service unit has a 32-litre tank, dry break couplings and comes in a travel case. It's suitable for all racecars, including prototypes

Manthey's driver cooling system is available with everything you need to fit it in your racecar and help keep your driver hydrated. Quick change system allows for rapid refilling during a pit stop

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Ease of passage

The idea of using GT3 cars in competition around the world was supposed to be easy, but there are still multiple technical challenges in doing so

By ANDREW COTTON

When the GT3 category was launched, it had a wide variety of competitors. It was a class that featured the likes of Morgan's Plus 8, resplendent with a wooden dashboard, as well as Corvette's C5 Z06 and Aston Martin's DBRS9.

The idea was to provide an accessible, cost-effective racing platform for various one-make series cars, including the Porsche Carrera Cup and Ferrari Challenge, that could, for the first time, compete against each other.

The basis of the class was that whatever was brought, the cars would have their performance balanced and be good to race, with very little adaptation needed. The original concept was to balance the cars to within 0.75 of a second, the thinking being that the amateur drivers would make a bigger difference than that and would remain the determining factor in the result.

With the tools that were available, Peter Wright, who managed the performance balancing, was clear – no one could balance the cars any more accurately than that.

Cheaper thrills

As the GT2 and GT1 categories continued to increase in cost, more teams and manufacturers turned to GT3 cars that were less expensive to buy, cheaper per kilometre to run and easier to drive. When the FIA GT1 World Championship died, GT3 cars stepped into the void, while GT2 cars morphed into the GTE category that ran until last year.

The GT3 class was a natural fit for those manufacturers who developed and built ever-more elaborate machines. More professional drivers sat behind the wheel, factory teams were entered and all-pro driver line ups put more pressure on the BoP committees to balance the cars to within a tenth of a second. And the arguments raged.

The volume of the disagreements increased as the prizes grew, first to include the 24 Hours of Spa, and this year, for the first time, Le Mans. The 'phone lines will, almost certainly, now be a cacophony.

The oriinal appeal for teams and drivers was that the cars were cheap and cheerful. The appeal to manufacturers was they could sell cars in large volumes around the world, and set up large customer racing departments to build and service them.

This was all fine while it remained customer racing. Now, however, as the class has morphed into more professional motorsport, the cars and technology have increased in complexity.

Downforce has increased and, in turn, the demand for power. Costs have risen and customer service departments are decreasing in size. It now appears that the cars are aimed more at competition than the mass market, with manufacturers now selecting teams and series in which their cars can run.

Despite this, the ability to sell the same base car for global competition is still an attraction for GT3 manufacturers. However, the race series themselves have very different processes for balancing the cars, and this has led to additional complications for the manufacturers. The costs to develop the cars for this process alone must be met somehow, which is why the prospect of GT3 becoming too expensive is now a reality.

BoP on the head

Each series has a slightly different set of criteria based on competition factors such as other classes, track layout and nature, environmental aspects such as noise levels, and their own individual ways of testing. That has caused the likes of General Motors (Corvette) and Ford, both of which are starting out on their GT3 journey with new cars, to undertake different homologation processes to have their cars accepted.

By having very different processes, the results are also dissimilar, which makes it challenging for the organisers to use data from other series when balancing their own.

Each of the series runs dyno testing to establish a baseline map for the engine. Some then map the aero using wind tunnel data from either Windshear in the US or Sauber in Switzerland. These tests are then backed up with track data, but there are key differences between the series that skew the results.

Wind tunnels help to build an aero map of the cars ahead of their on-track running but that data has to then be validated in the real world. Windshear in the US and Sauber in Europe are the tunnels of choice for GTs

It appears that the cars are aimed more at competition and less the mass market, with manufacturers now selecting teams and series in which their cars can run

In the FIA World Endurance Championship this year, for example, torque sensors are mandated for the GT3 cars, which means power at the wheels is measured after losses through the gearbox and differential.

Meanwhile, in series such as IMSA, and events organised by the Stéphane Ratel Organisation (SRO), there is no torque meter but air restrictors are used, which only regulate maximum power output from the engines. *Racecar* understands IMSA will introduce torque meters next year, which will bring the series into line with their European cousins, but manufacturers still face big differences for the SRO-organised events, and the Nürburgring 24 Hours.

'Vette bill

For General Motors, putting its new C8 Z06 GT3.R through the various homologation processes has taken months of planning and testing, just to have a car deemed ready to race. That organisational challenge has fallen to its programme manager, Christie Bagne, and the first stage of the homologation process for its GT3 model began in June 2023.

Only when this has been passed will the FIA issue a technical passport for the car. This crucial document details the specification of the car that then goes to the market for sale.

The problems start when one of the different homologation processes request a big change, which can send the manufacturers back in an iterative loop.

'If you make a big intake change, for example, you will likely have to go back and do the dyno testing again,' explains Bagne. 'If we did make a change targeted for a certain series, but it goes into our homologation document, that could also impact us.'

The wind tunnel tests, for example, are now famously difficult due to differences between the two tunnels used, which mean the aero results gained with the same car can be different. This was discovered in GTP testing, and subsequently with GT3.

The idea is to create an aero map to validate the manufacturer-supplied data. To do so, cars must run at various attitudes, and be within a prescribed performance window of lift and drag.

General Motors is familiar with the personnel and processes at both tunnels, which makes life easier for the American manufacturer. As does the fact it has already put several GTE cars through the process.

'We go to Windshear and do the dyno test and that's the initial characterisation of the car,' explains Bagne. 'We send a lot of data back and forth before that to introduce the data sheets that are expected so, by the time we do any test, we have already developed a relationship between our technical personnel and theirs.'

Corvette also sent a number of parts to the wind tunnels to prepare for the tests. That, then, set the initial BoP for the Daytona 24 Hours, which was validated at a test held in December 2023. Track testing there backed up the theoretical results, and IMSA set the tables for the pre-race test, held the weekend before the 24-hour race in Florida.

There, the results were analysed again, and changed for the race, with Corvette ordered to add one degree to its wing angle and carry an additional two litres of fuel. IMSA was trying to level the playing field, but is always battling the teams in whose interest it is to hide performance for as long as possible.

GT World Challenge

Once the American race was out of the way, Corvette's homologation team had to prepare for the SRO test, held at Paul Ricard in the south of France in March.

The SRO uses the FIA's wind tunnel data to help build an aeromap of the car, but does not use the data from the WEC's dyno testing, despite the same dyno being used for both series. The data cannot be carried over from one series to the other due to the different restrictor requirements in the two series.

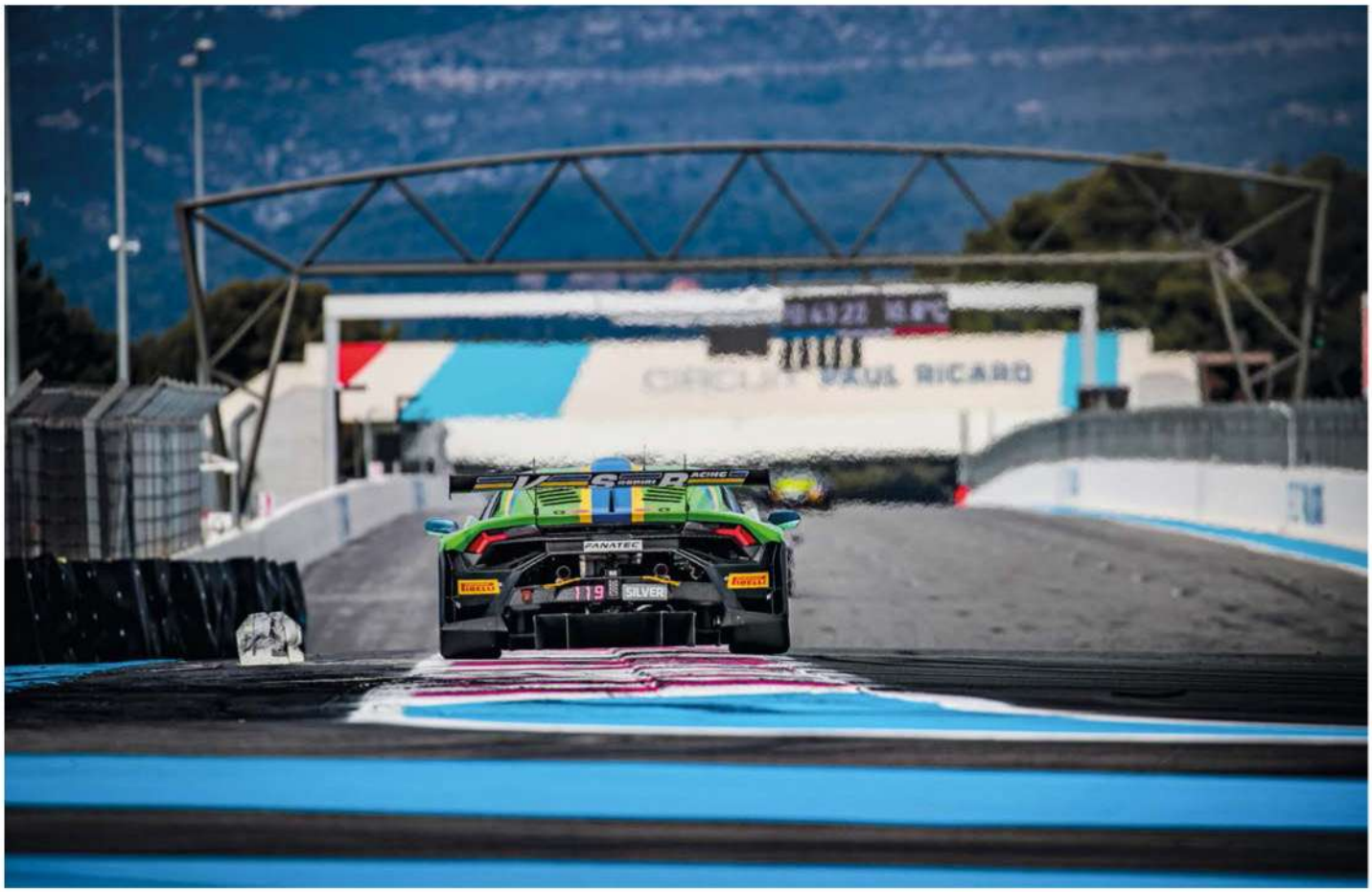
The problems start when one of the different homologation processes request a big change, which can send the manufacturers back in an iterative loop

Once dyno testing is complete and the engine capabilities established and balanced, the aeromap is considered. The cars are then run on the Paul Ricard circuit over several days, using different track layouts to mimic the circuits used during a season. The idea is to map the cars in the real world before the SRO team undertake the balancing act.

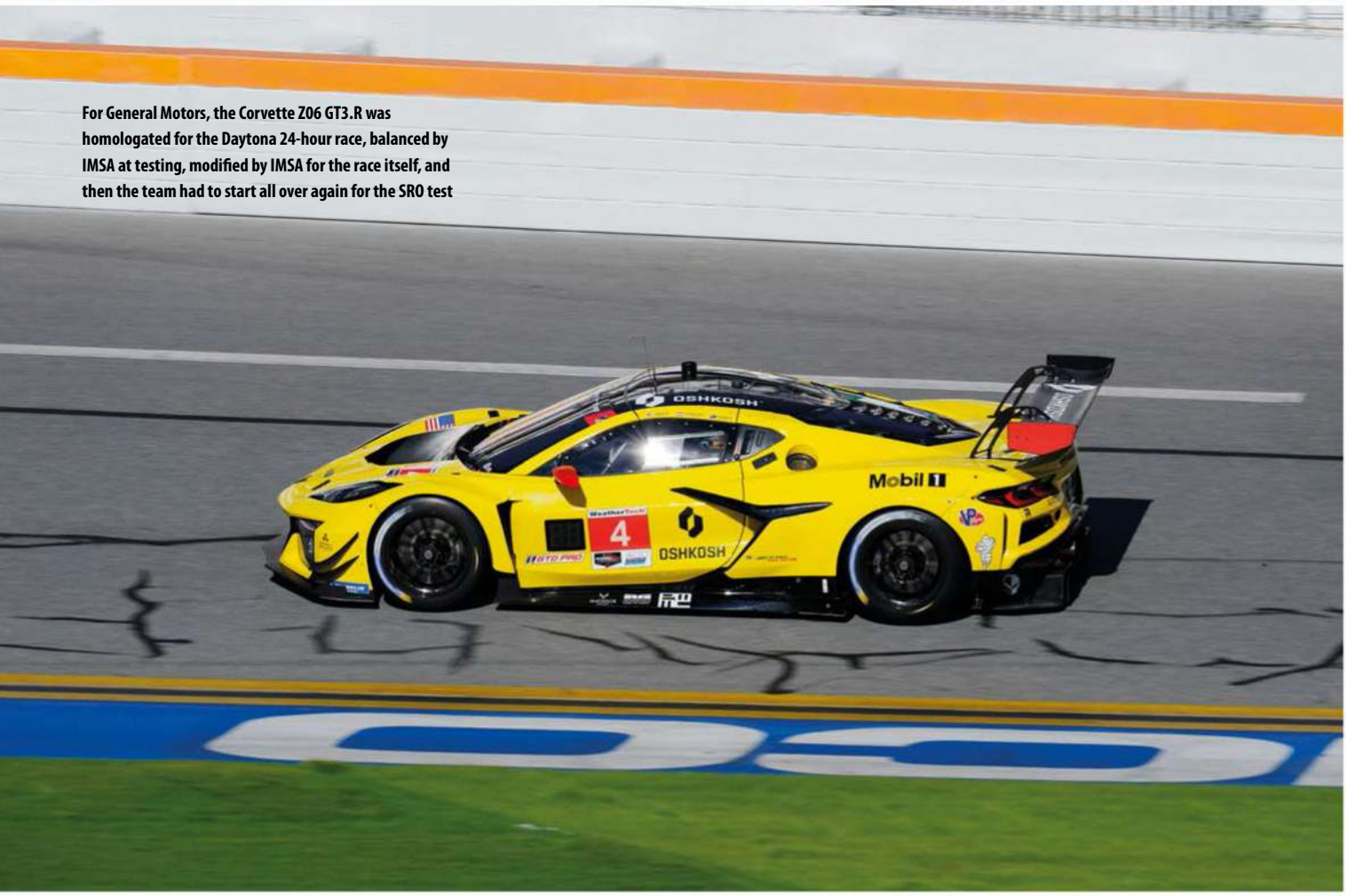
The power requirements are also different for the SRO events, compared to the WEC and IMSA, which means a further adjustment to the mapping of the engine. Oh, and the tyres are different too, with the SRO using Pirelli.

Following all these tests, the cars are balanced. However, the SRO is unique in that it categorises the race circuits it runs on and provides a different BoP for each type of circuit. Category A includes the ultra-low downforce circuits such as Monza and Macau, while Category B takes in the likes of Spa, and Paul Ricard without a chicane on the straight.

In previous years, that has allowed the BoP engineers to mimic at least some of the



Another problem, or two, is that not all series use the same tyre suppliers or fuel. Different fuels mean disparate consumption figures and fuel allocations, while tyres obviously affect set-up



For General Motors, the Corvette Z06 GT3.R was homologated for the Daytona 24-hour race, balanced by IMSA at testing, modified by IMSA for the race itself, and then the team had to start all over again for the SRO test

Generating accurate data is the most important element for the technical teams, and each have found different ways of doing it

attributes of Spa in real-world competition, with high top speeds and high-speed changes of direction at Signes corner, in preparation for the Spa 24 Hours.

Category C circuits cover pretty much every other permanent track, while the final grouping, Category D, provides for street tracks and high downforce configurations.

The idea of GT3 was to provide an affordable, accessible racing platform where cars built for one-make series could all race against each other, all over the world. The problem is effectively balancing cars in series that operate with different homologation requirements

The idea behind this seemingly complicated process is that the BoP can be proactive and more tuned to the real world.

Potentially complicating matters further, the SRO (which does not use torque meters or the fuel flow metering system to balance its cars) will introduce renewable fuel this year for the first time, although we understand it will be the same TotalEnergies specification that the WEC has used since 2022.

WEC and Le Mans

Generating accurate data is therefore the most important element for the technical teams, and each have found different ways of doing it. For the WEC and ACO, torque sensors have been the chosen method, though this has been controversial.

The WEC has two-car teams, normally with some factory assistance, and sending driveshafts to MagCanica in California to have the sensors fitted is a time consuming and expensive process for the teams.

For a customer racing-focused programme, with tens, or even hundreds, of cars sold for competition per manufacturer, torque sensors are unaffordable.

Series organisers also come up against the wily nature of the manufacturers. Suffice to say, the data may not always be as reliable as the cost would suggest.

'[Torque sensors] mean you are no longer targeting air restrictor size; you are defining an air restrictor size that allows you to meet the power target and then managing the torque control using torque axles,' explains Bagne. 'So, you might be running a 50mm restrictor in IMSA and, say, a 60mm in WEC, but you aren't necessarily running with more power in WEC because it is being managed through torque controls.'

Having the major series go to torque sensors is a step in the right direction in terms of reducing variables between them, but customer teams are nervous that they will be priced out of the market and into the waiting arms of the SRO's second-coming GT2 class.

Introducing torque sensors across all series will even things out a little, but customer teams are nervous about the cost implication

Into the 'Ring

After completing the process for IMSA, the WEC and Le Mans, and the SRO, GT3 car manufacturers then have to turn their attention to the Nürburgring 24 Hours. Here, the nature of the track rather dictates what package the cars will run. The circuit is undulating, bumpy and extremely fast, requiring a different set-up to anywhere else.

'It makes sense that it is different at the Nürburgring,' says Bagne. 'Given that you are running the car at a higher ride height, you might need a different aero package, different fenders and wing settings on the car that we wouldn't run anywhere else. And there's a different exhaust we have to use there, too.'

The latter point came as something of a surprise, but it's because the Nürburgring has different noise restrictions compared to the other race circuits visited.

'For the Nürburgring, it's a bit of a power cut control problem,' confirms Bagne. 'For example, if your car is in the air you need to cut power by regulation. So, your Nürburgring settings are such that if the car suspension is at full droop, you are cutting your power, and that means there's another set of controls you have to put into it.

'I would say there is a lot of series-specific development just to make sure you have a

Further complicating matters is the Nürburgring 24 Hours, which has more open GT3 regulations including a tyre war. Manufacturers have different ways to prepare for the unique 25km track

'I would say there is a lot of series-specific development just to make sure you have a competitive and legal car, which is why we take it so seriously when we look at expanding into different series'

Christie Bagne, programme manager at Corvette Racing

competitive and legal car, which is why we take it so seriously when we look at expanding into different series.'

When you also factor in the different fuels used, which means consumption figures are unique to each series, so fuel allocation varies, and tyres that are championship specific, it's obvious why any series will struggle to get its BoP correct.

'In defence of the series, sometimes you see somebody complaining about the BoP because they feel it is causing them a problem, but that might not be what it is,' explains Bagne. 'It could be that the team is having trouble managing a particular tyre, or getting into the set-up window, or the track surface has changed. 'Or it could be that some teams had the opportunity to test there while others didn't. There are so many factors that go into the performance of the car that are beyond the Balance of Performance.'

Competitive edge

There's no doubt a lot of engineering horsepower goes into setting the cars up for the various different series. To comply, manufacturers need to sell 20 units within the first two years of homologation, and the cars have to remain affordable. With so many manufacturers now producing GT3 cars, they need to be immediately competitive, and the manufacturer must support its teams, too. Only after all that can the teams confidently go racing, which is when the Balance of Performance arguments really become public.

For the manufacturers and the programme managers, after the amount of work they have done to bring the cars into the performance windows, and the money invested to meet the different rule sets, they then have to successfully manage their support in order to win races.

So, while in theory the cars race in the same specification around the world, in practice there remains a world of difference between the various series.

Championship specifics

FIA GT3	
Wind tunnel	Sauber
Torque meters	MagCanica
Fuel flow sensors	Sentronics
Fuel	TotalEnergies
Tyres	Goodyear
IMSA	
Wind tunnel	Windshear
Torque meters	N/A
Fuel flow meters	Sentronics
Fuel	VP Racing Fuels
Tyres	Michelin
SRO	
Wind tunnel	FIA / Sauber
Torque meters	N/A
Fuel flow sensors	N/A
Fuel	TotalEnergies
Tyres	Pirelli
Nürburgring	
Wind tunnel	N/A
Torque meters	N/A
Fuel flow meters	N/A
Fuel	Open
Tyres	Open

You hear a lot of complaints about the BoP being wrong, but teams are not always accounting for the many other performance factors involved, including track and environmental changes

Lost cause?

The dysfunctional relationship between motorsport and data acquisition

By DANNY NOWLAN

XPB

Good data acquisition should be the race engineer's best friend, but you don't need F1 levels for it to work. Effective use allows you to see in real time what your engine and chassis are doing

Having been in this business for nearly three decades now, one of the things that amuses and frustrates me in equal measure is the dysfunctional relationship motorsport has with technology. This is put into even sharper relief given how racing promotes itself to the outside world as a technology-based sport.

And nowhere is this more acute than with motor racing's relationship with data acquisition, which I liken to the classic Jekyll and Hyde paradigm, but on acid.

As we'll explore in this article, good data acquisition should be motorsport's best friend.

Make no mistake, the two most significant technical innovations of motor racing in the later part of the 20th century have been aerodynamic downforce and data acquisition. Both have transformed the sport.

The former needs no introduction, but the latter has been just as key. It used to be that car and engine set up was art, combined with a certain amount of guess work, but data acquisition transformed the game because suddenly you could see what was going on with both your engine and chassis.

I freely admit there is no way ChassisSim could ever have happened without the rock solid foundation data acquisition provided.

Yet, despite all this, still so many general punters and regulatory bodies regard data acquisition with distrust and fail to see what they have in their hands.

Downhill slope

Where it all went wrong with data acquisition and motorsport lies in the beginning. The big end of town spent a fortune on sensors and processing power that was largely useless.

Table 1: Core data channels you need to log

Channel	Role	Frequency
Engine rpm	Engine/Chassis	50Hz
Engine temperature	Engine	10Hz
Oil pressure	Engine	10Hz
Lateral acceleration	Chassis	200Hz
Vehicle speed	Chassis	50Hz
Inline acceleration	Chassis	200Hz
Vertical acceleration	Chassis	200Hz
Steering	Chassis	50Hz
Throttle	Engine / chassis	50Hz
Front brake pressure	Chassis	50Hz
Rear brake pressure	Chassis	50Hz
Gear position sensor	Chassis	10Hz
Damper position FL	Chassis	200Hz
Damper position FR	Chassis	200Hz
Damper position RL	Chassis	200Hz
Damper position RR	Chassis	200Hz
GPS altitude	Chassis	10Hz

Fig 1: Aero correlation (coloured is race data, black is simulated)

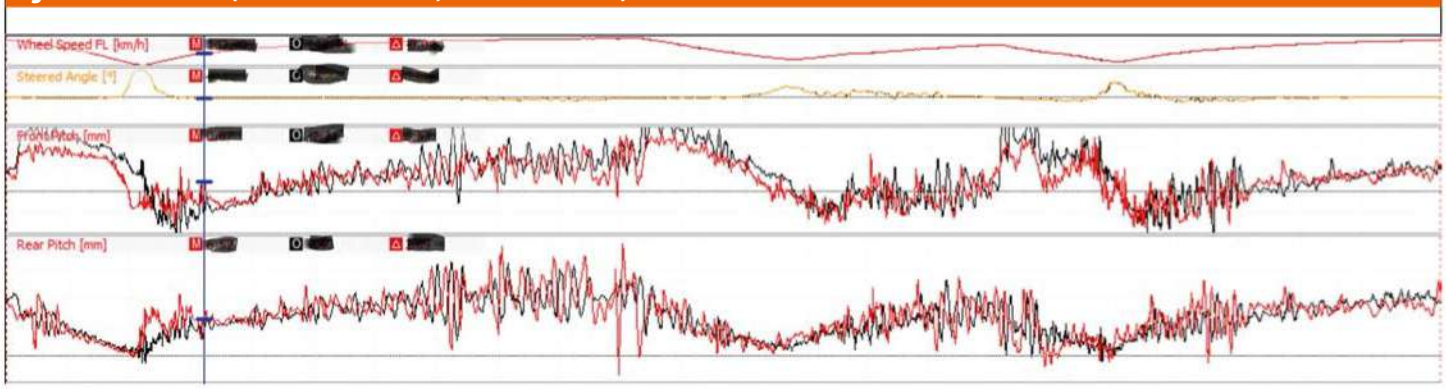
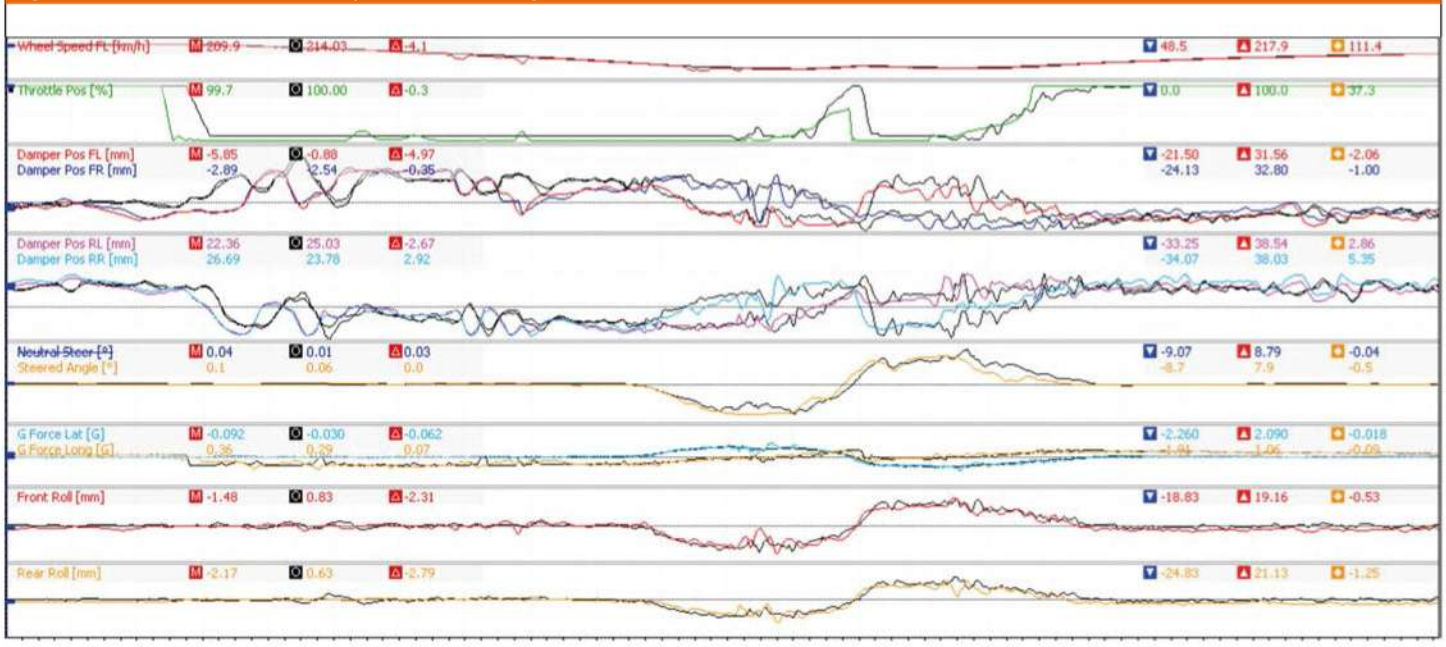


Fig 2: End result of the ChassisSim tyre force modelling toolbox



Unfortunately, this started the reputation that data acquisition was / is expensive, irrelevant and therefore had to be banned, or at least its use severely limited.

Combine all that with the resident techno hysteria that's present in motor racing and it was all downhill from there.

The reality is totally different.

What you need to log in order to get a proper handle on your racecar can be distilled down to 17 channels, which are presented in **table 1**.

Table 1 isn't just based on textbook theory. What I have outlined is the basis of the ChassisSim monster file and the engine channels are the first port of call for any engine diagnostic you should be looking at when the car is initially downloaded.

Brake pressure channels are essential for driver coaching and monitoring the health of the braking system.

Logging gear position is a good thing but, honestly, you can infer it from data.

I've also added the vertical *g* sensor and GPS channel because recently I have found these invaluable for completing circuit models that account for camber and track undulation.

Equally importantly, implementing this list of channels will not break the bank.

I'm not just saying all this because I'm an isolated, theoretical purist. What I have listed is the lived experience of the ChassisSim community over the last 20 or so years. Indeed, the bulk of the ChassisSim vehicle models out there have been reverse engineered from acquired race data.

Grey areas

When it comes to vehicle dynamics, the two grey areas are always aerodynamics and tyres and the ChassisSim monster file is the bed rock of how you quantify both.

The two most significant technical innovations of motor racing in the later part of the 20th century have been aerodynamic downforce and data acquisition

As a case in point, let's look at the end results of using the monster file to create an aeromap, as shown in **figure 1**.

What you are seeing is correlation for a racecar with sub-optimal aero (to put it politely) and an aeromap that still needs a fair bit of tuning.

Apart from a few exceptions, the bulk of the data overlays perfectly. The reason it can do that is that every damper pot you have on the car is effectively a load cell. From that, you can figure out what the tyre loads are, and everything else flows from there.

This is what is at your fingertips when you have data acquisition that's been done right.

The situation is even starker for tyre modelling, and an example of using the ChassisSim tyre force modelling toolbox is shown in **figure 2**. As always, actual data is coloured and simulated data is black.

Note the fifth and sixth traces that are the steering, lateral and longitudinal *g*. Granted, this was with a driver who knew what they were doing, but the results show what you can derive from well calibrated and properly set up data. Not to take advantage of this is just madness.

Michael L Levitt

Compared to the cost of wind tunnel time, CFD and tyre modelling, data acquisition is affordable to racers competing at all levels. Key is understanding what the data acquired is telling you

You can also readily create a circuit model with a car fitted with the channels outlined in **table 1**. From the lateral acceleration you can deduce the curvature file, which describes the path the vehicle takes. This is shown by **equation 1**.

$$iR = \frac{1}{R} = cv\_sign \cdot 127.008 \cdot \frac{a_y}{V^2} \quad (1)$$

Where,

iR = curvature (1/m)
a_y = lateral acceleration (*g*)
V = vehicle speed (km/h)
cv_sign = sign of corner (+1 for a_y being positive for a right-hand turn, -1 for a left-hand turn)

This brings us to one of the best kept secrets of data analysis. The road surface profile can be reverse engineered from the dampers (the ChassisSim bump profile modelling is an excellent case in point).

You can also reverse engineer the road camber from the vertical *g* accelerometer and GPS data (a spin off from **equation 1**).

Table 2: Breakdown of prices for data logging equipment (MoTeC option, others are available)

Item	Price (Australian dollars)
MoTeC ADL 3	$5000 (approx. US$3250 / £2600)
3-axis accelerometer	$1200 (approx. $780 / £625)
Damper pots	$400 (approx. $260 / £210)
Steering sensor	$200 (approx. $130 / £105)
Throttle sensor	$200 (approx. $130 / £105)
Temp sensor	$200 (approx. $130 / £105)
Pressure sensor	$400 (approx. $260 / £210)
Brake pressure sensor	$197.50 (approx. $128 / £100)
GPS package	$400 (approx. $260 / £210)

As data acquisition clearly provides a cost effective and powerful way to level the playing field, why do so many racing series either heavily restrict its use or ban it outright?

Here, we just sub a_z for a_y and look at the vertical curvature from the road surface provided by the GPS altitude. Compare this to the normal curvature calculated from a_z and the difference is the road camber. Pretty straightforward, huh?

If at this point you're worrying about the price, I've provided a breakdown for a MoTeC system capable of doing all this in **table 2**.

So, the cumulative total is AUD $9600 (approx. US$6290 / £4980). To be complete, we should add in a further AUD $1500 (approx. US $983 / £778) for installation and wiring, which gives a total outlay of around AUD $11,000 (approx. US$7208 / £5708).

When you consider that running a GT3 can easily cost you €15,000 (approx. US$16,216 / £12,837) for a day's worth of testing, and if you want to pay a tyre manufacturer for a tyre model, you're looking at €10,000+. That's not half bad (I'm not even going to get into what you are on the hook for if you want to generate a CFD aeromap, or put in some serious wind tunnel time).

Don't get me wrong, all of these tools have their place but, as we have seen in **figures 1** and **2**, good data goes a long way.

For those of you reading this that are involved with club motor racing, let me just say that what I have presented is the silver-plated option. You can get started for around half that price using something like an AIM logger and more budget orientated sensors. You might need to replace those more often, but they'll get you going.

Money saver

Aside from all that, there is a much more fundamental paradox we need to address here. As data acquisition clearly provides a cost effective and powerful way to level the playing field, why do so many racing series either heavily restrict its use (Brazil's Stock Car Pro Series, for example, forbids the use of damper pots) or ban it outright, as in most oval racing categories in North America?

This is fantastically short sighted because what then inevitably happens is the teams with the biggest budgets just spend more trying to replicate what they don't have. I know this is what happens because I have been directly exposed to it.

Suffice to say, what some teams spend makes the MoTeC data budget shown in **table 2** look like pocket change.

So, can someone give me a logical and well thought out answer as to how restricting and / or banning data acquisition saves money in the long term? This becomes even more acute when you ban testing, which is ultimately even more destructive.

The bottom line is, if you are serious about levelling the playing field in any race series, you *need* to allow data acquisition. Otherwise, you'll simply be enforcing the *status quo* and paying an unnecessary fortune for the privilege.

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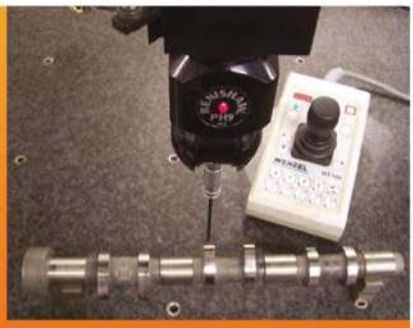

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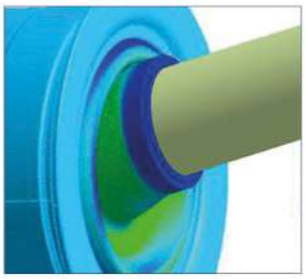

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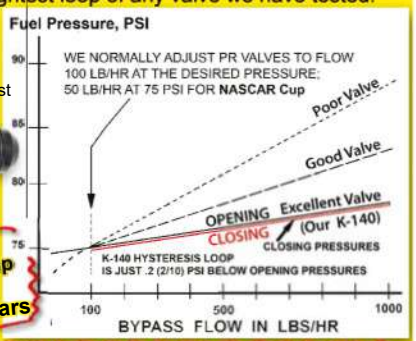

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Audi calls time on its rally-raid programme after Dakar win

Having finally achieved its goal of an outright win on the Dakar with its RS Q e-tron, Audi has put an end to its rally-raid programme after three years.

The German manufacturer had considered entering this year's FIA World Rally-Raid Championship season but decided not to, following an evaluation of spare parts and production timelines.

In a statement, Audi explained that 'extremely high spare parts consumption' over the last couple of years had depleted its supply of components.

Two Audis crashed out of the 2023 event and the manufacturer embarked on an intensive test programme to validate its upgrades for 2024. It entered this year's event with three cars and took victory with the one driven by Carlos Sainz, alongside Lucas Cruz.

Audi's analysis found that lead times in the production of one-off parts, such as the front and rear differentials and lower wishbone at both axles, could be as long as two years, due to what it described in the statement as 'very few, highly specialised suppliers for [the] extremely complex prototype'.

'It was a hard-earned and extremely emotional victory for a highly motivated team,' declared head of Audi Motorsport, Rolf Michl. 'Team Audi Sport and Q Motorsport showed exemplary team spirit in a particularly tough edition of this challenging event. After setbacks last season, we managed to turn the tide and prevailed this time against strong teams and very good drivers.'

DPPI

The hybrid drive Audi RS Q e-tron featured an ex-DTM engine that powered an energy converter to charge the axle-mounted Formula E electric motors

Business as usual at Le Mans

The International Business Days Le Mans convention will return for its 16th edition this year, taking place on 12-13 June in the build up to the famous 24-hour race.

Key industry figures and decision makers will take part in a range of forums and meetings to drive discussion about the future steps for mobility and motorsport.

Round tables will consider topics such as how motorsport is a powerful technological accelerator; multi-material additive manufacturing; hydrogen as an energy carrier of the future, and electric vehicle life cycles from production to consumption.

Personalised one-to-one meetings are another key aspect of the IBDLM and are designed to instigate business collaborations.

Product showcase demonstrations will take place in the Additive Manufacturing Village, while start-up pitches for new companies and a job fair aimed at engineering students cater for the next generation of professionals.

Tech talks with engineers from Le Mans tyre suppliers, Michelin and Goodyear, and guided tours of the paddock, are also on the agenda.

Finally, a trackside dinner during the night practice session completes the schedule.

The first IBDLM convention took place in 2008 and the event typically attracts more than 120 attendees, including race teams, parts suppliers, manufacturers and service providers. Representatives from aeronautics, rail and road are also involved.

The International Business Days event brings industry discussion to the Le Mans paddock, with forums, product demonstrations, tech talks, a job fair and informal networking opportunities

Confirmed participants so far include Angst & Pfister, ARRK LCO Protomoule and TMD Friction, who specialise in technical assistance, rapid prototyping and friction material manufacturing respectively.

The IBDLM24 will take place in the Technoparc du Circuit des 24 Heures on the Wednesday and Thursday of Le Mans race week, putting industry at the heart of one of the world's largest motorsport events.

‘More robust’ F1 tyre in 2025

Pirelli is planning to make next year’s range of updated Formula 1 tyres ‘more robust’, based on simulation data the tyre manufacturer gathered over the winter.

The Italian supplier is gearing up for adjustments ahead of the final season of the current ground effect regulations, aimed at reducing overheating whilst maintaining the strategy element of multi-stop races on different compounds.

‘We had the simulations from the teams at the beginning of December,’ said Pirelli’s motorsport director Mario Isola. ‘We received their simulations with an estimation of the loads and speeds, and stress on tyres [through to] the end of 2024.

‘According to these numbers, there will be an increase in performance. [So] we decided to work a bit in the beginning of our test campaign to design a more robust construction.’

Isola stressed that ‘doesn’t mean heavier’ but, rather, that the tyre structure must be more resistant to fatigue.

‘The first part of the development for 2025 will be focused on this,’ he added. ‘Then, we have to re-design the compound range in order to reduce overheating.’

When a tyre’s surface becomes overheated, it reduces the car’s grip and leads to sliding. Grip can be recovered by slowing down for a lap, which is acceptable in qualifying, but overheating contributes to thermal degradation of the tyre, which increases with mileage.

Having previously been under review, the retention of tyre blankets in F1 is helping to manage the overheating problem.

‘It’s a big challenge,’ admitted Isola. ‘What we can do is modify the working range of the compounds in order to protect the overheating a bit more. Construction is important, because the way in which you distribute the pressure on the dynamic footprint, it’s important to ensure we don’t have any peaks anywhere. These two elements together should reduce overheating without affecting thermal degradation too much.’

Pirelli conducted two real-world tests for potential 2025 tyre options in early February, involving Ferrari at Barcelona (1400km) and Mercedes and Aston Martin at Jerez (2500km).

Pirelli needs to finalise its updated tyre construction by September 1 and has until December to decide on compounds. The supplier can choose how many slick compounds it uses, but Isola suggested that sticking with five would be suitable for the variety of tracks F1 visits.

XPB

Pirelli plans to test its 2025 tyre options after at least four of this year’s GPs, along with private runs

European home for Porsche Penske 963

Porsche Penske Motorsport is set to unveil its new European hub, a purpose-built facility that will house its World Endurance Championship cars and team.

In typical Penske style, the attention to detail is impressive. There is even a full-size replica of a Le Mans garage at the facility, which will be officially opened on April 9.

‘Our state-of-the-art facilities have to deliver everything we need to operate across two continents – between Mannheim, Weissach and Mooresville – and globally as a race team,’ says Jonathan Diuguid, managing director at Porsche Penske Motorsport.

‘The building, originally designed and built by Porsche and then acquired by Penske as a Porsche dealership, has been re-modelled and modernised to support the needs of racing and servicing our hybrid-powered Porsche 963 racecars around the world.’

The new hub houses office space, conference rooms, digital networking facilities and workshops, with four areas for car construction and maintenance, as well as suspension and weight adjustment.

There are also departments for pre-assembly, racing equipment, carbon composite processing, high-voltage systems and spare parts, as well as storage and logistics.

Penske has re-purposed an ex-Porsche dealership into a state-of-the-art hub for its WEC campaign

IN BRIEF

The FIA has appointed Jan Monchaux as technical director in its single-seater department. Monchaux, formerly of the Sauber Formula 1 team, will report to Nikolas Tombazis, the FIA’s single-seater director.

The FIA WEC increased the ballast weight of LMH prototypes to +70kg over the minimum weight of the car, which stands at 1030kg. Previously, the maximum weight the cars could race at was 1080kg.

Mercedes’ grand prix team has become the first to sign the Climate Pledge to reach net zero carbon emissions by 2040, having already switched to the use of alternative fuels for land and air travel for its team members.

Pirelli has renewed its tyre supply contract to the Bathurst 12 Hour, and will now continue to partner the race until 2028.

The unofficial Bathurst lap record was broken twice in February. Firstly, Mercedes sent an unrestricted GT3 car to Mount Panorama, fitting it with carbon brakes, a new exhaust, wider floor, drag reduction system and no air restrictor. It achieved 1m56.60s in the hands of Jules Gounon, but was eclipsed only eight days later by the all-electric Ford SuperVan 4.2. Romain Dumas lapped the 6.2km circuit in a time of 1m56.32s. The SuperVan boasts a total power output of 1050kW and has 600kW of ‘regen.

Peugeot has confirmed it will debut its Evo 9X8 at the second round of the WEC season at Imola in April. The car, which will now run on the same 29/34 front / rear tyres as its competitors, will have moved the weight rearwards as far as possible and will run with a rear wing for the first time.

The Autobmobile Club de l’Ouest has published its entry list for this year’s 24-hour race and it features 62 cars, including 23 Hypercars, 16 LMP2 and 23 GT3s. Alpine, BMW, Lamborghini and Isotta Fraschini join Hypercar, while all the GT3 cars are new to Le Mans.

The BTCC and its hybrid partner, Cosworth, have been awarded first prize for Outstanding Achievement in the field of Motorsport Engineering by the IMechE’s Automobile Division.

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Eclectic, not electric

Multiple solutions are the way forward in the journey to net zero

The business of motorsport in 2024 is looking really strong and confident. Most race series appear popular, are attracting good support from new fans, and the influence of Formula 1 continues to grow, drawing attention from sponsors and partners across the board.

The Motorsport Industry Association (MIA) has attracted an increasing number of companies to come on our business development visits to NASCAR in the USA and the Motor Valley supercar community in Modena, Italy.

Our free to attend, trade only, CTS 24 Show in October at Silverstone, UK is already 50 per cent sold out for exhibitors, nine months in advance! These are all welcome signs of a buoyant, confident market this year.

In February, the MIA explored the exciting commercial future of motorsport in 2030 and beyond, with 250-plus insightful business leaders at our annual EEMS24 Discussion Forum. It is clear that motorsport's journey to net zero is a positive one, with an eclectic mix of rapidly developing opportunities (not simply electric) that are ideal for the industry's agile supply chain.

You only have to look at the entry list in this year's Dakar Rally to see the breadth of investment in a wide variety of solutions.

F1 chief technology officer Pat Symonds said the rate of change is unprecedented and urged the EEMS audience to 'push the boundaries of possibilities and think big.'

Brand recognition

Mainstream automotive is beginning to recognise how motorsport is creating a powerful, international business identity of value to the public, and their future. High performance cars, with motorsport input, are increasing sales and brand recognition internationally.

They also see a motorsport-based community that delivers results to tight deadlines and so informs vital strategic decisions in complex times. Competitive engineers doing battle on private land in motorsport, testing and validating different power solutions, is proving to be a great benefit to automotive and delivering new revenues to our industry.

The limitations of electric solutions, and their likely costs, are under the spotlight and, where possible, being overcome.

However, this situation has encouraged many other net zero ideas to be considered, and rapidly developed, to meet potential global market demand.

The majority of the EEMS audience, when asked to vote on which solution should be the primary commercial focus over the next five years, said 'all of them!'

Over 250 knowledgeable business leaders took part in the EEMS24 Discussion Forum

Sustainable fuels, hydrogen combustion, electric, hydrogen fuel cells and hybrid were all discussed, and it was made very clear that the combustion engine is far from dead.

The journey of sustainable fuels is well underway. In the next three years, both Formula 1 and MotoGP will use fully sustainable fuels. F1 pledges to have net zero carbon emissions by 2030, the date when the FIA has committed to being fully net zero.

Increasing sponsorship and investments, in all forms, is the fuel that will keep motorsport thriving during this exciting future. Provable sustainability is increasingly vital to attract sponsorship from major brands. For example, 75 per cent of millennials seek out and buy environmentally friendly products, and 60 per cent of female F1 fans look for brands that support diversity. These new fans are increasingly savvy and diverse. Winning is just one reason for their loyalty: they will not buy from brands with a poor environmental record.

Sustainability is no longer just an option, for it will be driven forward consistently by customers' and fans' demands. As a result, motorsport buyers will require suppliers to meet challenging sustainability standards, so it is worth starting work on this now.

Forward thinking

We asked all delegates at the conference to look into the future and share their thoughts. The overwhelming response was that all open-wheel motorsport will, over the next decade, follow the lead of F1 in using sustainable fuels. Endurance racing will see increased electrification alongside sustainable fuels and an increase in the use of hydrogen. Off road will be similar, but with BEVs involved in some way. Touring cars, being closer to mainstream automotive, will embrace hybrids and other solutions that are attractive to the car-owning public. In this way, touring cars could be a valuable test bed for on-street performance for the future.

Our motorsport community welcomes new technologies with open arms and open minds. It has become a powerful advocate for alternative solutions for mobility. It innovates fast and accepts risks and failures as it drives to deliver results on time. This approach means solutions are continually being revised, developed and moved forward.

Motorsport reacts to challenges and delivers solutions to satisfy sporting regulators, not politicians, so keeping clear of the muddle that is mainstream OEMs and the BEV future. While links with politicians can help unscramble this difficult situation, motorsport can move forward, meet challenges and demonstrate the real-world solutions and technologies the world needs.

The MIA welcomes companies looking to grow their businesses and enjoy these challenges. To discuss becoming part of our motorsport business family, contact me (chris.aylett@the-mia.com). I can answer your questions and help you get your fair share of business in 2024.

Chris Aylett is CEO of the MIA (Motorsport Industry Association) www.the-mia.com

Mainstream automotive is beginning to recognise how motorsport is creating a powerful international business identity of value to the public, and their future

Racecar engineering
Inside the world of modern motorsport technology

Cost control?

Further proof that limiting choice is not the answer

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The thorny subject of what was going to happen to the next generation LMP2 category cars has finally been resolved and, while the solution may not be that surprising, it has significant impact. Each of the four LMDh chassis manufacturers will have to abide by the regulations to which they originally signed up and turn their top-class prototypes into LMP2 cars. In a market that is shrinking, it's now a matter of who will lose the least amount of money to do so.

The story can be traced back to 2017, when the FIA and ACO decided to bring the class under control. They wanted it to be a pro am category and everything was done to protect it, other than to limit choice. The common belief at the time was that by limiting choice, costs would be kept under control. This, as we have so often written, is a fallacy, and that has proven to be the case here, too.

Gang of four

The number of chassis suppliers was reduced to four. Engine and gearbox choices were limited to one. Engines and chassis were price capped and it looked good, at least for the four constructors that were appointed: Dallara, ORECA, Multimatic and Ligier.

However, there were a few flies in the ointment. Firstly, the cars were extremely quick, which was fine while the hybrid LMP1 cars were even quicker, but a disaster when the Hypercars were brought in and proved to be around 15s/lap slower at Le Mans.

The FIA and ACO now have an ill-handling skateboard in a one-make class

The LMP2 cars then had to be handicapped to make room for them. From lap times of 3m25s at Le Mans, they were slowed to around 3m35s through a combination of restricted engine power, reduced tyre and aerodynamic performance and gear ratios. This made the cars heavy, clunky and horrible to handle for the bronze and silver graded drivers at whom the cars were originally aimed.

Secondly, the constructors needed to upgrade their cars to compete against the benchmark chassis, built by ORECA, and so put in a series of requests to change the handling and performance. These requests went to the FIA, which considered them on an individual basis and partially agreed in some cases. Immediately following this, there has been domination by the ORECA 07 that remains to this date. The FIA and ACO now have an ill-handling skateboard with 600bhp that competes in effectively a one-make class.

Meanwhile, IMSA's top class prototypes, the DPi cars, were based on these LMP2 chassis and the American rule set produced cost-effective racecars. So, the FIA decided to retain the same link, despite doing the process in reverse. The spine of the top class LMDh car, including chassis and suspension, could become the basis of the next LMP2.

Manufacturers had already paid for the development of the car, so it should have been a straightforward process. In reality, though, it wasn't. ORECA and Dallara were clear in that their LMDh cars were built to the standards of LMP2, including use of materials and ability to scale up production. Multimatic was clear that it didn't want to build an LMP2 version of its LMDh, while Ligier didn't have an LMDh partner (until Lamborghini turned up).

The LMP2 grids were full in the WEC, in IMSA and in the European Le Mans Series, but then the GTE class was killed off in favour of GT3. There are many more manufacturers with GT3 cars than GTE, so grids quickly reached breaking point. The solution by the WEC then was to eliminate the LMP2 class for 2024. It was clear that, despite the cars being popular, the market was shrinking, and so the four chassis suppliers agreed the market could only support a maximum of two of them.

Logic dictated the two to bow out should be Multimatic and Ligier, except they didn't want to go.

The uncertainty dragged on for a year, until at Daytona it was confirmed that all four manufacturers will build cars, and take losses. It was explained to me that building a car to an LMP2 rule set was challenging, and those that hadn't done so would lose more that those that had.

Ongoing costs

It doesn't quite work like that, though. The big cost is in supporting the customers at the track, and each of the four must also support teams running their cars. Those that already send a large number of trucks to a race will be well covered. Those that don't, and who need to support teams in the US, Europe and Asian Le Mans series, will suffer more.

In a way, the 2017 LMP2 class did what it was supposed to do. The cars were fast, popular and, above all, safe. The next generation will be cheaper to run than Hypercars, and will continue without hybrid systems in their new guise.

Despite this, the FIA and ACO cannot claim these cars achieved what was intended. LMDh cars are expensive and the constructors will struggle to make money on their LMP2 versions under the cost cap, but teams will again have a choice of four. ORECA will likely keep its existing customers, but we can hope for some variety when the new cars come.

ANDREW COTTON Editor

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